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CONTENTS:

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THE STATUS OF THE ALGO-LICHEN HYPOTHESIS.

BY THOMAS A. WILLIAMS.

IN treating this subject it will not be out of place to give first a short history of the growth of knowledge concerning lichens and their structure. The earlier lichenologists knew but very little of lichens as now understood, and comparatively nothing as to their internal structures. As the magnifying power of microscopes was increased, so the knowledge of the lichen thallus was increased. The affinities of lichens to the discomycetous fungi on the one hand and to the algæ on the other were early noticed and commented upon, and some species have been alternately placed among the fungi, then among the lichens, and others have been repeatedly changed from lichens to algæ, and vice versa. Later authors, as Cornu and Tulasne, consider the lichen very near if not belonging to the Ascomycetes. while De Bary, Krabbe, and others place them among the Ascomycetes without any doubt as to that being the proper place for them.[1] Lately Cora and several other genera have been placed among the lichens under the name of Hymenolichens—*i.e.*, lich-

[1] Stahl found the reproductory organs of Collema to be very similar to those of the Discomycetes. Borzi confirmed Stahl's observations by his own. Fünfstück, after a study of the development of the apothecia of Peltigera and Nephroma, believed that "the reproduction is by apogamy, with rudimentary sexual organs, as in Podosphæra among the Discomycetes." De Bary says (Morph. and Biol. of Fungi, etc.): "The formation of the perithecia of lichens from the primordial coils of hyphæ follows in general the same course as that of Xylaria, Polystigma, etc." This is confirmed by the observations of Krabbe, Füisting, and others who have made an extended study of the Cladoniæ, Sphyridium, Lecanora, Lecidea, etc.

ens which, according to Johow, are made up of the hyphal elements of a hymenomyceteous fungus and an alga. Massee claims to have discovered a Gasterolichen. So that now we have lichens placed among the Ascomycetes and the Basidiomycetes, and by good authority.

Wallroth (1825) was the first to make any study of the gonidia. He was followed by Koerber (1839), who studied them more fully than did Wallroth. But not until 1851 was made anything like an explanation as to their probable origin and subsequent growth. This was done by Bayrhoffer. He asserted that the gonidia came from the "fibrous stratum, the fibres of which swelled at the top and produce male gonidia." Speerschneider, who was the next to study the gonidia, differed from Bayrhoffer on some points, but agreed as to their probable origin. Schwendener, in his earlier works, took a similar view, basing his argument on the fact that the gonidia, many of them, seemed to be connected with the ends of the hyphæ. De Bary, in his work of 1865, agreed with Schwendener as to the heteromerous lichens, but in case of such species as belong to the Collemaceæ, etc., he said: "Either the lichens in question are the perfectly developed states of plants whose imperfectly developed forms have hitherto stood among the algæ as Nostocaceæ and Chroococceæ, or the Nostocaceæ and Chroococceæ are typical algæ, which assume the form of *Collema*, *Ephebe*, etc., through certain parasitic Ascomycetes penetrating into them, spreading their mycelium into the continuously growing thallus and becoming attached to their phycochrome-containing cells." This gave to Schwendener the idea of *dualism* which he afterward formulated and presented to the world. Such was the beginning of the much-debated "Algo-Lichen hypothesis." Schwendener in this famous theory declares that all lichens, so-called, are dual organisms, consisting of a fungus, parasitic upon an alga, whole colonies of which it envelops with hyphæ. These algæ he divides into two classes, Phycochromaceæ, or those with bluish-green coloring matter, phycochrome, and Chlorophyllaceæ, or those containing chlorophyll. The first of these he divides into five types: 1, Sirosiphoneæ; 2, Rivularieæ; 3, Scytonemeæ; 4, Nostocaceæ; 5, Chroococceæ. The latter he separates into three types: 1, Confervaceæ; 2, Chroolepideæ; 3, Palmellaceæ. To some one of these types, he claimed, the gonidia of every lichen could be referred.

About this time Famentzin and Baranetzky by cultivating the gonidia of several lichens (*Physcia* [*Theloschistes*] *parietina*, etc.)

produced zoospores. These in time developed into unicellular algæ, and by judicious management they produced several generations. Although they drew different ideas from this the Schwendenerians immediately took this as an argument for the dualism of lichens. Later (1872) Woronin confirmed the observations of Famentzin and Barentzky by his own experiments made with *Parmelia pulverulenta.*

When Schwendener propounded his theory one of the first to accept it was E. Bornet. He immediately began a series of observations and experiments to prove it. In his treatment of this subject (*An. de Sc. Nat.*, vol. 17, ser. 5) he divides his observations into two divisions corresponding to those of Schwendener—*i.e.*, those made upon lichens with chlorophyll-bearing gonidia, and lichens with phycochrome-bearing gonidia. Under the chlorophyll-bearing gonidia he found those belonging to such genera as Trentepohlia, Phyllactidium, Protococcus, Cystococcus, Pleurococcus, etc. He found the gonidia of several of the Opegraphæ, as *O. varia,* to be Trentepohlia. The branches of the alga were found ramifying the tissues of the bark, frequently going so far that the hyphæ of the lichen-fungus could not follow them. As they near the outer surface of the bark the hyphæ and algæ became more and more interlaced until they reached the thallus proper. When studied at all ages of the thallus the nature of the relations between the two were easily seen to be such as to preclude every chance of the one being developed from the other. The study of other lichens with similar gonidia, as *Verrucaria nitida, Rocella phycopsis, Chiodecton nigrocinctum,* etc., led to the same conclusions.

The gonidia of *Opeg. felicina* he found to be a Phyllactidium. The broad thallus of this alga was so large that the hyphæ did not entirely envelop it, but by gradually branching, surrounded parts of it and even sent small branches *into* it. He found in an old thallus of *Opegrapha varia* the normal filaments of Trentepohlia together with sporangia, showing that it could not be the "first stage of the lichens," but was an entirely separate plant. He sowed the spores of *Physcia* (*Theloschistes*) *parietina* on *Protococcus viridis,* and found that the hyphæ of the germinating spores readily enveloped the algæ, and did not envelop any other objects with which they came in contact. He also sowed spores apart from the algæ, and although germinating and producing hyphæ as did the others, they produced no gonidia and died as soon as the nourishment from the spore was consumed. He obtained similar results with *Biatora muscorum.*

As to those lichens containing phycochromgonidia, he found that Colothrix furnished gonidia for *Lichina pygmæa* and *confinis;* Scytonema and Lyngbya were found in such genera as Pannaria, Erioderma, and Stereocaulon (Cephalodia); Nostoc was found in Collema and allied genera; Etigonema in Ephebe, Spilonema, etc.; and Glœocapsa in Synallisa, Cora, Omphalaria, and similar genera. Sometimes he found the alga to be very little changed by the parasitism as in Ephebe and Spilonema; at others they were so changed as to be recognized only with difficulty. Two modes of contact were noticed: 1. Where the hyphæ are applied simply to the surface of the algæ, as in Peltigera, Stictina, etc. 2. Where the hyphal branches enter the algal cells, as in Physcia, Omphalaria, etc. From these observations he draws the following conclusions: that since Trentepohlia, Phyllactidium, etc., are so complex in their nature, and since no instance of the hyphæ enlarging and producing them has been found, and since these algæ (Phyllactidium, Trentepohlia, Nostoc, Protococcus, etc.) are found in the free state, there can be no doubt of the dual nature of those lichens containing them, and that, 1st, all gonidia can be referred to some algal type; and, 2d, the relations between hyphæ and gonidia are such as to exclude all possibility of one being produced from the other, and the theory of parasitism alone can explain these relations satisfactorily.

Reess made a series of cultivations with spores of *Collema glaucescens* sown with *Nostoc lichenoides*. By careful manipulation he produced a complete Collema thallus, but lacking the fruits. He saw the germinating spores "send out hyphæ which branched and forced themselves into the Nostoc."

Treub used the gonidia of one species of lichen and the spores of another. His success was similar to that of Reess

Stahl uses the hymeneal gonidia and spores of *Endocarpon pusillum* and spores of *Thelidium minutulum*. He succeeded in producing a fully developed thallus, showing that these hymenial gonidia are ejected at the same time as the spores, to serve as gonidia for the young plants. He cultivated these hymenial gonidia separately, and found them to grow and divide just as do the undoubted unicellular algæ. Lately Bounier has succeeded in producing a complete lichen thallus with mature fruits by using lichen spores and algæ.

Among the botanists in the United States who have favored Schwendenerism in their later works are Dr. Asa Gray, Dr. Bessey, H. Willy, etc.

Most of the English lichenologists, together with Koerber, Nyland-

er, and Th. Fries, oppose the theory of "dualism of lichens." There are, however, several different ideas as to the origin of the gonidia, Fries holding one opinion, Nylander another, and Crombie, taking a mean between the two, seems to believe either. Muller supports the "micro-gonidia" theory of Dr. Minks, as did the lamented Professor Tuckerman. Nylander, while acknowledging the external similarities between lichens and ascomycetous fungi, asserts, as does Crombie, that there are too many differences between them to admit of their being placed together. "The hyphæ of lichens," he says, "are perennial, tough, thick-walled, straight, and insoluble in hydrate of potassium, while the hyphæ of all fungi are soft, thin-walled, flexuous, immediately dissolved in hydrate of potassium." Besides the "Lichenian reaction" is seen in all lichens and in none of the fungi. Both these points are denied by many eminent lichenologists and fungologists. De Bary has found the "Lichenian reaction" in several undoubted fungi. Hartog, de Seynes, etc., say that fungal hyphæ are no more soluble in hydrate of potassium than are lichen hyphæ.

Nylander also speaks of the "improbability" of the lichen hyphæ being endowed with the reason and sagacity necessary to search out a peculiar kind of algæ which it may imprison and press into service."[1] He further urges, as does Crombie and others, that no algæ will grow in such bare, exposed places as those chosen by most lichens. Cooke, who uses this same argument, says further that those lichens that do grow in low, wet places, as Collema, etc., are by some authors supposed to be algæ themselves and therefore should not be used in an argument for Schwendenerism. Nylander, however, takes an opposite view and places many of the algæ of Schwendener and Bonet, etc. (such as Sirosiphon, Scytonema, Stig nema, Nostoc, Trentepohlia, etc.) among the lichens, as he has found fruits upon them. But he finds no hyphæ. From these discoveries he argues that even if there is parasitism, it is not that of a fungus upon an alga, but rather of a lichen upon a lichen. He was one of the first to place Cora among the lichens.

Crombie says that finding and producing of zoospores in free gonidia does not prove that gonidia are identical with algæ, but that they are *only similar to them.*

The autonomists raise quite an objection as to the relative size of

[1] Why is it that any parasite, either vegetable or animal, is generally limited to but one or at most to but a few species upon which it feeds?—Heredity, etc.

"Parasite" and "Host," and insist that there can be no such a thing as a "mutual benefit" parasitism in nature as is claimed to be present in case of the lichen-fungi and the algæ. The latter objection Sargent explains (*Am. Mo. Mic. Jour.*, Feb., 1887) by saying that while the algæ furnish the necessary nourishment for the fungus, the latter in turn protects the former from excessive dryness and sunshine, allowing only enough softened light as is necessary to decompose the carbon dioxide, and, by acting as a sponge, takes up water readily and retains it, thus insuring at least a moderate supply of water for the algæ even in dry weather; moreover, it is a well-known fact that fungi in growing give off carbonic dioxide. This the lichen hyphæ furnish to the algæ, and they in turn give back oxygen, etc., to the hyphæ. As to the fact that some lichens grow in comparatively dry places, he thinks that this is not a very serious objection, since in some lichens we have hymenial gonidia which are ejected together with the spores; in others soredia, by means of which new plants can be formed without the aid of spores. Again, the species of algæ supposed to act as gonidia are those species that have become adapted to the frequent dry spells incident to terrestrial life. He further insists that the differences between the fungal-algal elements of a lichen and free-living fungi and algæ are just those differences that would result from the parasitical relationship claimed by the dualists.

Nylander says that in no case do the gonidia arise from the hyphæ, but from the parenchymatous cortical cells observed by him in the prothalline filaments of germinating spores. Crombie formerly held that the gonidia might come from the hyphæ or the hyphæ from the gonidia. Later, he says the gonidia are of thalline origin. He claims to have seen the germination of spores and growth of young lichen thalli on rocks, etc., where no algæ or gonidia could be seen. At first only the young hyphæ were seen. Later, gonidia were found. These he believes to have originated in certain glomerules noticed on the young hypothallus. These glomerules he claims contain gonidia in various stages of development. They finally become thicker and form the cortical layer. He then uses Nylander's explanation as to the free state of the gonidia in the interior of the thallus: "The cortical stratum gradually increasing and extending is at the same time dissolved (resorbed, physiologically speaking) beneath, and the gonidia consequently become free." Crombie says further that "the contact between the hyphæ and gonidia is in no way genetic or parasitic. . . . The gonidia are

neither adnate to or penetrated by the hyphæ, but only adherent to them by the lichenin. . . . In all cases the apparent union is simply amylaceous adherence, and the fancied penetration the result of erroneous observation." He says that Stahl's observations are of no account, as he is a very careless observer, etc.

Koerber, who is one of the best of observers, while he opposes Schwendener, admits that "the germinating spores must have free gonidia belonging to the same species in order to develop a complete thallus," but that "these gonidia are not algæ belonging to the lichens as a fungus, but *gonidia* previously separated from the thallus and which have become 'asynthetic.'" He practically admits the whole thing.

Hartog says, speaking of Crombie's arguments, that he either utterly ignores the strongest points in favor of "Parasitism" or laughs at them and says "improbable," or that they are the result of "poor work" and "erroneous observation." To use a favorite Cookian phrase, both Cooke and Crombie answer many of the best arguments in favor of "Dualism of Lichens" simply by "rhetoric."

It is a noticeable fact that in a new country where new groves of trees are being planted, before the trees show any signs of lichens they are covered, especially on the north side, by "green slime," and the thicker the "green slime" the more rapid is the growth of the lichens when they do appear. Again, it is noticeable that when lichens begin to grow on fences and trees they take the dampest, coolest, shadiest places first, and gradually, if it all, extend to the dryer places, as seen on fences where boards cross the posts, where the lichens may be seen to extend a short way from the post along the centre of the board, avoiding the dry, windy edges. Our largest lichens are almost always found in the darkest woods. These facts show that lichens in general are not the "lovers of light, dry places," as one author claims. But on the contrary, while they do not choose such places as do the saprophytic fungi, they generally choose places where plenty of the lower algæ are to be found.

Most of the botanists who have made any experiments with spores, gonidia, and algæ have obtained results conclusive enough to convince them that Schwendener is right.

In conclusion, we now have lichens belonging to the Ascomycetes, the Hymenomycetes, and the Gastromycetes, according to most of our latest and best authors. The gonidia are pretty conclusively proven to be algæ, notwithstanding Crombie's "rhetoric;" and the

parasitism of the fungus hyphæ on the algæ has not only been shown to be possible but quite probable, and to be the only way to explain the peculiar relations existing between hyphæ and algæ satisfactorily. Schwendenerism, like "The Heterocism of Rusts," may be considered as a settled fact, and our "beloved lichens" must sooner or later be placed among the fungi, where they rightly belong.

The University of Nebraska, Dec., 1888.

AMONG THE ANCIENT GLACIERS OF NORTH WALES.

BY F. JOHNSTON EVANS.

THERE are few spots in the British Isles which present so many attractions to the geological tourist as that most picturesque of localities into which the traveller by rail from Holyhead is suddenly ushered when the "Wild Irishman" express, which had been rushing at the rate of some sixty miles an hour across the Island of Anglesea, after emerging from the Menai tunnel, somewhat abruptly pulls up at Bangor station. Around on every side are piled strange rock formations, tilted and upturned in every conceivable fashion. Within a comparatively short distance are the famous slate quarries of Penrhyn, in themselves a beautiful study; while in nearly an opposite direction are visible the lofty summits of Snowdon and Cader-Idris. Let the reader accompany me in imagination into the midst of this magnificent mountain region, our special object being to wander and speculate, for a brief space, among the ancient glaciers of North Wales. Proceeding through the Vale of Llanberris, we perceive, lying high above the road, near the top of the pass, a huge block of stone which has long attracted the notice of even the least observant traveller. It is perched on the edge of a rock a few hundred feet above the bottom of the valley, on its northern flank—that is to say, on the left hand of the traveller who is ascending the pass. It is from fifteen to twenty feet long, and six or seven feet high, sharp and angular as on the first day that it was detached from the parent mass. It rests on a face of rock which, for a few feet, slopes sharply towards the valley beneath, and then ends in a perpendicular face of rock, and it is so lightly poised on its narrow base, that

a finger-touch would seem sufficient to dislodge it from its precarious position. The thought involuntarily occurs, how came it there? What agency could have transplanted it thither without rounding or breaking off a single corner, and left it where it stands, with so cautious and gentle a hand that it rests securely not at the edge but on the side of a steep and smooth incline? It is utterly impossible that it could have rolled thither; for if so, the momentum which carried it to its present position, must have precipitated it down the cliffs below. In all probability, any force which could have moved it three inches from the top of the incline on which it rests would have been sufficient to send it crashing down to the bottom of the valley. Hardly any traveller can have passed up the vale—from one part of which this rock forms a very conspicuous object—without having had some such thought presented to his mind. Those, however, who are aware that the existence of a great glacier in this valley at some remote period is a geological certainty, will be at no loss to recognize in this rock a remarkable and most characteristic specimen of those transported blocks whose occurrence in various parts of the world, at great distances from the parent formation, was so long a mystery to the philosophic inquirer, but which are now recognized as among the surest indications of glacial action.

Climbing now from the high road to the block I have been describing, we perceive that it is only one—although much the larger—of a great number of similar blocks, which are deposited in the same manner on the sides and at the edges of the sloping or precipitous faces of rock which flank the northern side of the Vale of Llanberris. The greater part of these extend in a well-marked and tolerably regular line, and at elevations varying from 300 to 500 feet above the course of the stream, for perhaps a mile further down the valley—until, in fact, its sides become too steep and precipitous to admit of such deposits being made. Clambering along this side of the valley, we examine the faces of the rock around and beneath these blocks, and find many of them—especially such as have not been exposed to the action of the water-courses which trickle down here and there into the stream below—deeply scored with the characteristic striæ of glacial action. If we now cross to the opposite or southern side of the valley (the flank which lies beneath Snowdon), we shall find all the indications of glacial force—the deep notchings of the striæ, the polished and rounded surfaces which continental geologists term *rochers moutonnés*, and the transported blocks poised

in the most critical manner upon slopes which seem too steep to give them support—still more clearly and unmistakably exhibited.

The transported blocks and glacier scratches in the Vale of Llanberris are so well known to geologists that I simply refer to them to call to the mind of the reader the general aspect of the phenomena which I am about to describe as occurring in other parts of the Snowdon district, where they are not so well known, or so universally ascribed to the action of an extinct system of glaciers. Just at the top of the Vale of Llanberris, there is a hollow in the profile of the ridge which forms its northern boundary. It lies exactly between the cluster of houses called Gorphwysfa on the south, and the lake of Cym-ffynnen, at the base of the two Glyders, on the north. A few hundred yards to the east or southeast of the lowest part, at a distance of not more than 300 yards from the great block of the Vale of Llanberris, there is a little round knoll of rock which rises by itself above the neighboring parts of the ridge. It is something like an inverted basin, so that the ground falls away pretty steeply on either side, and the top is nowhere less than fifteen or twenty feet higher than the surrounding parts. Perched on the very top of this knoll, resting on three points of contact at most, is an irregular piece of rock, of a different formation from that upon which it rests, seven or eight feet long, three or four broad, and as many high. It has never been subjected to any process of abrasion or rounding, for every corner is perfectly sharp and angular—presenting in this respect a marked contrast to the rock on which it rests, which is round and smooth, and somewhat weather-worn. What could have brought this block to its resting-place? To have rolled thither it must have rolled some twenty-five feet up-hill, from whatever direction it had come. The ridge, for some hundreds of yards on either side of the knoll, rises but gently, and presents an undulating surface, along which a sharp oblong, irregular block of stone could by no possibility have preserved for any distance a considerable velocity: and between this knoll and the spur of the Glyder Fawr—the only considerable altitude within a mile of the spot—there is a hollow at least 150 feet in depth. But a little below the top of the knoll, on its eastern slope, is a still more remarkable block. It is about the same size as that which is seated on the summit of the knoll, and similarly sharp and angular, but consists of a coarse conglomerate of a very marked and peculiar kind, in which large round white pebbles, apparently of quartz, are imbedded in a kind of matrix, which looks like a coarse red sandstone. The

most incurious person can hardly fail to be struck with the great difference between the character of this rock and the clay slate upon which it rests. If the observer casts his eye around him, he will be unable to see in any direction traces of a similar geological formation in the neighboring rocks. A few feet further on, however, he will observe a third angular block of stone, larger than the others, but resting, like them, upon two or three points alone. He can hardly fail to be struck with the fact that these three blocks are in as exact and regular a line as if their places had been laid down by the nicest measurement. They run nearly northwest and southeast —about half a point to the west of N W. and to the east of S. E.— that being the general direction of the ridge which descends from the spur of Glyder Fawr.

If we now remount to the top of the knoll, we shall perceive that the side of the steep inclines towards the hollow referred to before, is dotted here and there with large blocks of stone resting gently upon the sloping rock, or imbedded in the turf. All these, on examination, will turn out to possess the same sharp and angular character; and all of these suggest the question: Is it possible they could have rolled so far up hill; and were it possible, could they be as sharp and unrounded as they are? Still, however, we see no sign of the red conglomerate. As we pursue our way northwest towards the spur of the Glyder, we find the ridge growing rapidly steeper, but still we see this regular line of sharp blocks, deposited often on their sharpest edges, and nearly on the edge or backbone of the rock. As we mount, they become larger and more frequent, and amongst the higher rocks are one or two small fragments of red conglomerate—until at length, just behind a huge mass of clay-slate of a size which would do credit to any moraine in Switzerland, we come suddenly upon a block of conglomerate fifteen feet long and ten feet high, large enough and sufficiently overhanging to afford us no mean shelter from a Welsh mountain storm. Five minutes' further climbing in the same direction brings us to a most gratifying sight—a large patch, seventy or eighty yards wide, of the red conglomerate *in situ*—of exactly the same character in every respect as that which we first observed resting on the side of the clay-slate knoll some two miles away. Looking back we shall be able to trace distinctly the line of stones by which we have been guided in our ascent. It is so regular that they might almost have been dropped one after the other by a railway train. On each side of the principal line of stones we may observe other

though less regular lines, by which we may very nearly map out the exact extent of the ancient moraine to which they belonged. The last deposited blocks are not a hundred feet higher than the outcropping of conglomerate; and we are now standing nearly upon the brink of the huge lake of ice which must have filled up the bason of the Glyder Fawr and the Glyder Fach, and poured out through the opening above the well-known little inn of Pen-y-gwryd into the valley of Gwryd, and terminated in the open space of the wide valley. Many of the rocks on the southern side of the opening, just above the lake which now occupies the bottom of the hollow between the two Glyders, present the general appearance of glacier-rounded rocks. But the material is so soft, and therefore so ill adapted for preserving the minuter and more indisputable marks of glacier action, that it would be unsafe to draw conclusions from their configuration, were they not supported by the independent testimony of the old moraine, which, with the exception perhaps of the moraine of the great glacier that filled up the whole basin of Snowdon, is the best defined that we may see in North Wales. The southern side of this hollow—forming the northern flank of the ridge along which lies the moraine of the Glyder—is also of a soft and easily disrupted stone, and much covered with turf and mould; and accordingly we are unable to find any very distinct marks of striæ. The places where the rock is least covered and has been least exposed to the obliterating action of trickling water, are the places where such indications could not be expected to exist—namely, near the top of the ridge, and on its southern flank, high above the Vale of Llanberris.

It is not easy to say to what system the great block in the Vale of Llanberris belongs. An attentive examination will show that it lies higher than the well-defined line of deposits which extend along the same side of the valley. Indeed, it is considerably above the level of the actual crest or col of the pass; and there is no precipitous or disintegrated height in its immediate neighborhood from which it could very well have been detached. Indications appear to be not wanting that the great glacier of the Glyder, at some remote period, rose above the lowest part of the hollow in the ridge toward the Vale of Llanberris, and overlapped the southern flank of the ridge. If so, this block, instead of belonging to the Llanberris glacier proper, is really a contribution from the stones of the Glyder glacier, and was brought down upon its surface from some

of the precipitous heights near the outcropping of the red conglomerate. Of this, however, it is difficult to speak with confidence.

We shall now select a new, and possibly a still more interesting route. At the head of the valley of Nant Francon, towering above Lake Ogwen and the high road from Bangor to Capel Curig, is the sharp and rugged peak called Tryfan—the most precipitous summit and the finest single mountain in North Wales. It is separated by a short, sharp ridge, running nearly north and south from the range of the two Glyders. Tryfan is an irregular continuation of this ridge, terminating abruptly on the Bangor road, and forming the western, as a spur of the Glyder Fach forms the eastern flank, of the romantic and secluded valley known by the name of Cwm Tryfan. The general level of this valley is considerably higher than the road, from which it is little seen, and as the approach to it is over broken and boggy ground, its very existence is unknown to multitudes of those who pass from day to day within a few minutes' walk of the spot. Yet it is one of the most curious in Wales. The explorer, on rounding the shoulder of Tryfan, comes suddenly upon a deep valley of gentle and tolerably regular inclination, half a mile wide and a mile and a half long, full, from one end to the other, of rounded and polished rocks of the most marked and characteristic aspect. They exist, not by the dozen, but by the hundred, and crop out from the moist turf all along the bottom of the hollow and to the height of several hundred feet along its sides. They are found up to nearly the same elevation along both sides of the valley, and above a well-defined line they cease altogether. Sometimes they are mere rounded knolls protruding through the turf and peat, but many of them are broad slabs and walls of living rock, hundreds of feet in length, every corner and angle of which has been carefully and elaborately rounded and polished off. More perfect specimens of the *rochers moutonnés* it would be hardly possible to imagine. Below the level of the glacier boundary, a sharp rock is not to be found, from one end of the valley to the other; and the vast number of the rounded knolls and shoulders, together with the general coincidence in their forms and in the directions of the polished surfaces, affords conclusive proof that they were subjected to the action of one uniform, regular and constant force. The glacier which filled up this valley must have been, like the glacier of the Aar in Switzerland, remarkable for the evenness of its surface, and for the uniformity of its motion. It must have been almost a *normal* glacier —for there are no sudden contractions of its channel, no anomalous

elevation of its bed. The direction of its flow must have been very nearly uniform, from its origin just beneath the ridge which connects Tryfan with Glyder Fach to its termination in the broad valley which the Capel Curig road pursues. Such a confirmation is unfavorable alike to the development of a large moraine and to the existence of that excess of pressure against the sides and bottom of the glacier which causes the deepest striations of the polished surface: and hence these indications cannot be expected to be found of so striking and unmistakable a character as in the "Cwy Dyll," the great hollow of Snowdon, with its irregular bed and contracted orifice, or in the narrow outlet of the gorge of Aberglaslyn. Nor is the rock of a kind favorable to the preservation of the minuter traces of glacier action. Still, some may be seen of a peculiarly interesting and instructive nature. The extreme regularity of the bed of the glacier, the unusual absence of all disturbing or anomalous conditions, has given rise to the formations of striæ of great length and regularity. Some of those which score the rounded rocks on the southern flank of the valley are as much as fifteen or twenty feet long, and very distinctly marked. They are the more interesting as they intersect the line of stratification, and are crossed at right angles by the superficial markings caused by the dropping of water. From the upper end of the valley the view is very striking. If we stand by the shore of the ancient sea of ice which has now melted from the sight, we can define with precision the limits which bounded it on every side, and look down upon a succession of worn and rounded surfaces, which though upon a smaller scale, are hardly less curious or characteristic than the old glacier bed of the Höllenplatte, which is crossed by the traveller from Meyringen to the Grimsel.

While one considerable glacier thus poured from the eastern base of Tryfan, one of immensely greater extent—so long, indeed, that it would bear comparison with some of the existing glaciers of Switzerland—streamed down to the northwest, occupying for many miles the valley of Nant Francon. This glacier had its origin in the romantic amphitheatre of rocks and precipices which surround Lake Idwal, one part of which is well known as the "Twll Du," or "Devil's Kitchen," and extended for at least five miles down the valley towards the spot on which Bangor now stands. The rounded and striated rocks which still tell the history of this glacier are to be found in considerable abundance, and of very characteristic form and aspects, all along the Vale of Nant Francon. No better speci-

men of a *rocher moutonné* exists in Switzerland than is to be seen on our left hand, as we are descending the valley, at the bridge just below Lake Ogwen, and within a few feet of the road. On the other side, the rocks rise precipitously above the road, and the glacier must have been borne with great force against the wall of rock which there checked its progress and altered its direction. Although the rock is not of a very durable kind, it is conspicuously rounded to a height of some 250 feet, where the limits of the glacier level are apparent. The upper rocks overhang the lower, and are very rough and jagged, with a trace of rubbing. Below the road on the left hand, terrace after terrace of rock is rounded and smoothed. This is the part of the valley where the glacier traces are most prominent and striking. Here, they actually obtrude themselves upon the eye, but they do not cease for many miles. The gently descending line of the glacier level may be easily traced from the road along the opposite side of the valley, the smoothing action being the more apparent from the contortion of some of the strata, as seen in the upper and unworn faces of the rock. Between five and six miles from Bangor is a very interesting group of rocks which crop out from the turf in a little wood above the road. They formed somewhat of an elevation in the glacier bed, and have consequently been subjected to severe pressure. They are worn very round and polished quite smooth, and the striæ are most distinct, passing sometimes up-hill, over the undulating surfaces.

The most striking evidences of glacier action, however, are to be found in the great hollow of Snowdon, which is literally full of them. From some distance above the Copper Lake, almost to the bottom of Nant Gwynant, they stare at us in the face at every step. The "Cwm Dyll" was one vast mass of ice from whose bosom the peak of Snowdon rose to the height of some 1000 or 1200 feet at most. Grib Goch, Grib-y-ddysgyl, Snowdon, and Lliwedd formed an amphitheatre of mountain peaks enclosing the great Snowdon glacier, as the chain of the Aiguille Verte and the de l'Echand guard the Jardin and the glacier du Talèfre; names doubtless more familiar to American travellers than those of the subsidiary peaks in the Welsh mountain ranges. A large proportion of the rock in the basin of the Snowdon range is very hard and smooth, and has preserved, in singular freshness, even the minutest scratches. It is curious to trace, as we descend from the summit of Snowdon into the bosom of the hollow, the gradually diminishing inclination of the glacier and its increasing pressure, as marked by the dimin-

ishing slope and deeper *intaglio* of the striæ. The moraine also of this glacier is wonderfully perfect. The cart-road from the now abandoned copper works is cut partly through the lateral and terminal moraines; and the sections might, save for the different geological character and the smaller size of the blocks, be that of the ancient moraine of the Mer de Glace between Les Tines and Lavanchi in the valley of Chamouni. There is the same utter absence of sorting in the disposition of the materials, and the same angularity in individual blocks—the whole being cemented together by a fine deposit of grit and sand. To use the words of Professor Forbes, in his description of the Chamouni moraine: "We find the mound to be almost entirely composed of detached fragments, rough and angular, or only rounded by partial friction, and accumulated in the utmost disorder, mingled with sand, without any appearance of stratification." Among the fragments of stone exposed by the cutting are some very interesting ones. They have originally belonged to the bed, or to the containing wall of the glacier, much higher up, from which they have been detached after being highly polished and deeply striated; and being now uncovered, they display the notchings and scourings, not, of course, in their proper and original directions, but just as they happened to have fallen when the stones were deposited in the places they now occupy.

It must have been a strange scene of desolate magnificence that North Wales presented at the epoch I am writing of. There were Snowdon and his associated peaks, the centres of one vast system of glaciers, pouring down on every side, east, west, north, and south—the Vale of Llanberris choked with ice, and fed from the heights and recesses on either side—a great glacier, taking its origin in the deep basin between Snowdon and Lliwedd, streaming up the valley of Nant Gwynant, diverted a mile or two above the site of the sleepy little hamlet of Beddgelert, by the opposing rocks at the lower extremity of Llyn y-Ddinas, and at length struggling through the narrow gorge of Aberglaslyn, rounding and scoring its rugged sides to the height of hundreds of feet. Another great glacier probably descended through the deep inlet which reached from below Llanberris to the very heart of Snowdon, extending to within four or five miles of the present coast line, and leaving records of its passage which to this day are apparent on every uncovered surface of rock along the Llanberris and Carnarvon road. Nor did the Snowdon glaciers, though the greatest, constitute the only glacier

system in Wales. It is certain that from the group of the Glyders and Tryfan, no less than three glaciers—one of vast extent—poured into the vales and plains below; and probably round every peak or group of nearly equal height, and whose masses are broken up into those deep hollows and amphitheatres which are so favorable to the collection of a reservoir of snow—and, in a climate of variable temperature, to the consequent development of glaciers—similar ice-streams must have filled up the valleys and choked the gorges in every direction. The great peculiarity of this scenery must have been the small elevation of the peaks and mountain ranges above the general level of the glaciers. In Switzerland the summits commonly tower for thousands of feet above the highest parts of the highest glaciers, properly so-called; and the great glacier basins and reservoirs are commonly bounded by huge aretes of bare and rugged rock, specked only with snowy deposits, such as the ranges which hem in the glaciers de l'Echand, the central tributary of the Mer de Glace, or which block up the extremities of the glacier of the Aar and the lower glacier of Grindelwald. In Wales, the corresponding heights must have been measured by hundreds, instead of thousands of feet, for many of the glacier basins themselves lie high; and in this respect, despite the magnificent effect of such a wide expanse of snow and of broken and crevassed ice, the difference must have been unfavorable to the grandeur of the scenery. Something of the same kind may be seen in the northern glaciers of Norway, though the heights which surmount them are higher above the glacier level than was probably the case in North Wales, and there is no reason to suspect the existence in Wales of those vast fields of snow whose aspect and distinguishing peculiarities are so essentially different from those glaciers, and which give to the scenery of Norway a character so unique and extraordinary.

THE FOOD OF THE OWLS.

BY W. S. STRODE, M.D.

A FEW years ago Pennsylvania, Ohio, and some of the more eastern States enacted laws offering a bounty of fifty cents per head for all hawks and owls that should be killed.

This munificent bounty aroused the professional hunters, and for the time being legitimate game was abandoned in many sections of

these States for the more remunerative business of hawk and owl shooting. Thousands were killed and the Raptores seemed in a fair way to be exterminated.

This merciless slaughter arrested the attention of ornithological and scientific societies, and they at once set to work to devise means to check the work of destruction.

Committees and individuals were appointed to investigate the food habits of the hawks and owls. Hundreds of dissections of stomachs were made, and after a thorough research the following report was made:

"*Resolved*, That the hawks and owls are of great benefit to the farmer and render him far greater service than injury, and that it is unwise to select any of them for destruction."

This report was concurred in by the leading naturalists throughout the length and breadth of the land, and as a consequence these obnoxious laws have been repealed.

A partial exception was made against the Sharp-shinned Hawk, Coopers' Hawk, and the Great-horned Owl.

It is to the latter bird that I will mainly give attention.

As the eagle heads the list of the diurnal birds of prey, so is the Great-horned Owl the most noble of the nocturnal birds, and the ancients chose well when they assigned to Minerva this bird as the emblem of wisdom.

Owing to a suitable habitat probably more of these owls are to be found in the Spoon River country of Central Illinois than in any other section of like limits in the United States. From my boyhood to the present they have always excited within me a lively interest and curiosity.

Their unsavory reputation as chicken thieves has led to their being destroyed whenever possible, and as a consequence in many parts of the country where they were once quite common they are now extinct.

This bad reputation and consequent destruction of this owl, in my experience and observation, is not all deserved.

Many times when a lad have my slumbers been broken in upon by my mother's voice calling up the stairway, "Get up quick! an owl is after the chickens." A careful investigation would reveal the intruder perched in the top of an apple-tree or on a limb close by the side of an old hen that would be waking the echoes of the night with her squalling. The owl in the meantime would be bowing and swaying his body to and fro, occasionally uttering a low

hoo! hoo! hoo! seemingly regarding the whole performance as a huge joke.

Unfortunately for the owl, this comedy would sometimes be quickly turned to a tragedy by a load from my shotgun, bringing him to the ground, and perhaps the hen also.

The principal food of the owl in the Spoon River country consists of small rodents, and the gray rabbit furnishes the greater part of it. Reference to my note-book for the years 1887–8 shows the following:

March 20, '87. Found a Bubo's nest in a large red oak tree, forty feet to first limb. seventy-five to nest. A tremendous climb, but with the aid of a splendid pair of climbers I got up to it, finding it occupied by a trio of downy baby owls of different sizes, who tried to look very fierce at my intrusion. In the nest with them was a whole rabbit and parts of another.

March 27, '87. Great-horned Owl's nest in white oak tree, standing in a steep hollow. Could see young birds from hillside above. An easy climb to the nest found it containing two half-grown young and half of a rabbit.

March 30, '87. Discovered a Great-horned Owl's nest in a cavity of a soft maple tree, thirty feet from ground. Found in it three young and parts of several rabbits.

March 31, '87. Located a Bubo's nest in an elm snag fourteen feet high, standing on a creek bank. Found in the nest three young owls with their feathers turned wrong end to, snapping their bills wrathfully and looking the very personification of fierceness. The largest of the three was half-grown, while the smallest was near the size of a quail.

In the cavity was one whole rabbit, the hindquarters of another, a flying squirrel, and a quantity of fish-scales. While I was sitting on a limb by the side of the cavity, watching the little fellows, the parent owls suddenly appeared upon the scene, and I had a cyclone about my ears for a few minutes. Such a whirl of feathers, claws, fierce eyes, snapping beaks, hootings and screechings about my head was calculated to terrorize one unaccustomed to the actions of this, the greatest of all the owls.

After continuing these demonstrations for a few minutes, one of them, the male I supposed from his coarse voice and white crescent under the chin, settled down upon a limb a few feet from the ground just over the creek.

His manner now underwent a change. Swaying to and fro for a

short time, he fell off the limb to the ground, and then tumbled about in the leaves in an apparently very crippled and helpless condition. My dog, that had been sitting all this time in a perfect frenzy of excitement at the foot of the stub, watching the owl, now forgot his training and made a headlong rush through the creek for the owl, but it was up and away, leaving him disappointed and crestfallen. I returned to the ground and departed, leaving this interesting family to the enjoyment of their well-furnished larder.

I subsequently learned that these young Bubos came to a tragic end. Some boys, finding them in the stub, threw them out into the creek, where they were worried to death by their dogs.

March 28, '88. Found a Great-horned Owl's nest containing two young owls, parts of a rabbit, and a flying-squirrel. Nest in a cavity in a soft maple.

March 29, '88. Bubo's nest in top of a white oak tree. An old nest of Red-tailed Hawk, two small young owls, a whole rabbit, and a half rabbit—a great deal more rabbit than owl.

March 30, '88. Nest in a wild cherry tree. A crow's nest preempted and reconstructed. Contained one young owl, a rabbit, a flying squirrel, and a robin. This is the only nest in which was found the remains of any bird.

Last spring, while out hunting Bubo's nests, I found a dead Screech Owl lying on the upper side of a broken plum tree limb. Its back, from the neck to the tail, was as neatly laid open as it could have been done with a sharp knife. I credited this piece of wantonness to the Great-horned Owl.

One bright day in March, '87, I was returning from a professional call. At this season of the year, when the hawks and owls are nesting, it is my custom, when not hurried by business, to leave the highways and ride haphazard through the woods, regardless of fences, hills, hollows, or creeks.

On this day I was riding leisurely along through heavy timber, down "Johnson's Creek," when my attention was arrested by the noisy cawing of a large flock of crows on the hillside two or three hundred yards to my right.

I at once guessed the cause of all this tumult to be a Great-horned Owl, for of all the denizens of the forest none other will so arouse the uncontrollable indignation of the family Corvidæ.

I had not thought of disturbing this camp-meeting of the crows, until suddenly a regular pandemonium of shrieks, and directly the scurrying by of a number of the sable birds, each one

shouting bloody murder at the top of his voice, plainly told me that something terrible had happened in the dark woods on the hillside above. Turning my horse loose, I went noiselessly up the hillside on a tour of investigation.

Presently a large Bubo flew up from the ground a few rods in front of me, and upon going to the spot I discovered the cause of the sudden great consternation of the crows. The owl had wreaked summary vengeance upon one of his tormentors, and the smoking body lay upon the ground in two halves, having been divided transversely instead of lengthwise as in the case of the Screecher. A part of the viscera had been devoured.

Last spring, while wandering about in the woods on "Geetur Creek," a tributary of the Spoon, I was attracted by the barking of my dog, and on going to him, found a young Bubo that had fallen out of the parent nest. It was in a little creek bed, and the parent owls had nicely concealed it by covering it up with leaves.

I decided at once to make a pet of it. A few days later I took from a family of four in a hollow sycamore a half-grown Barred Owl (*Syrnium nebulosum*), and placed it with the first, with the intention of studying and comparing the habits and dispositions of the two birds.

They are now full grown and have indeed proved to be very interesting pets. They have the run of an outhouse that gives them plenty of room to fly about in. They have become very much attached to each other, and if one is removed from their apartment the other is inconsolable until its return. And then such a bowing and nodding to each other is ludicrous indeed. The disposition of the two birds is very dissimilar. The Bubo is by far the nobler bird —as tame as a cat, good natured and intelligent, pleased at the appearance of familiar faces, but suspicious of strangers. Always greets my appearance at the door of the owl-house with a low hoo ! hoo ! hoo ! followed immediately by a shrill screech or at times almost a quack. Greatly enjoys having his head scratched; shuts his eyes, and his voice will sink almost to a whisper.

The Syrnium is just the opposite; untamable, sneaking, revengeful ; suspicious alike of everything and everybody. Anything from mussels to cats is relished as food. Fat or tallow they will not touch. Mice, rats, ground-squirrels, kittens, chicken-heads and small birds are first thoroughly crushed by their beaks and are then usually swallowed whole. Before swallowing birds they first pluck out their feathers.

It is said that if an owl once gets a taste of fish he is a fisherman ever afterwards, and of this fact I have seen many demonstrations.

At Thompson's Lake, on the Illinois River, I have several times in the dusk of the evening seen the Barred Owl feasting on discarded fish. The shutting down of the water-gates of the mill often leaves many small fish stranded on the gravel bed of the river, just below my house, and I have many times witnessed a pair of Great-horneds fly down from the trees on the opposite bank to feast upon them.

During the summer months small fish formed the staple diet of my pair of pets, and a pound of shiners three times a day was about the amount they required.

Their manner of feeding is very different. When a canful of minnows is poured out to them the Bubo will jump into their midst, and, as my boy sometimes remarks, "Just hog them down," two at a time.

The Syrnium will pick out a particularly lively minnow, eye it for a moment, then spring upon it and grasp it in the talons of one foot, and after holding it for a few seconds quickly transfer it to his beak, after which he will gaze about defiantly for a short time and then swallow it.

This bird has developed a great hatred for the boys, probably as a result of their disposition to guy him whenever an opportunity offers. This dislike has lately taken shape by his making a dive at every boy that enters his house, raking the top of his head with his claws as he passes over him, and then giving vent to his peculiar, laughing cry of "Who! hoo! hoo are you!" This trick he has played so often on the "gamins," that, at present, not one of them can be induced to enter his apartments.

Some days ago a venturesome lad laid his eye up to a knot-hole in the side of the owl-house to take a peep at them. His lusty screams quickly brought me from my office to his side. The blood was running freely down his cheek. The aim of the Syrnium had been unerring. From his perch on the opposite side of the building he had made a dive for the eye, and running one foot through the hole had lacerated the skin badly, but luckily not injuring the eye.

Sometimes I put a live rabbit in the owl-house, and then there is fun to see the Bubo getting up courage to attack it. No bully ever gave better evidence of a mixture of cowardice and bravado. He will bow and sway his body to and fro, run along his perch and back again, look to me for encouragement, then bow, look at the rabbit and bow, all the while uttering his shrill scream, which becomes

more and more fierce as his courage rises. Finally, after assuring him that he is a brave fellow, and no coward, to go for it, etc., he makes the attack. And now his whole nature suddenly changes, and instead of a hesitating bully he more nearly resembles a raging lion.

It is said that the tiny Downy Woodpecker more nearly resembles the great Ivory-billed than does any other of the many species of the family Picidæ.

The same may be said of the Little Screech and the Great-horned Owl, the little Scops being a tiny image in action and appearance of its great relative, from whom it probably evoluted.

In the spring and summer of 1887, at the request of Dr. R. W. Shufeldt, U. S. A., I was making a collection of nestlings of representative American birds, that was to be sent to Prof. Parker, of London, to be utilized by him in his great work on "Avian Osteology." Among the many birds brought to me by my boy collectors was a family of four young Screech Owls. Downy little fellows, all beak, claws, and eyes. Wishing to use but one of them as an alcoholic specimen, I was at a loss what to do with the others, as the nest from which they were taken was on a creek five miles away. I finally concluded to adopt them, and a family of kittens, which they resembled in many respects, would not have proved more interesting and trusting pets.

From first to last small fish was their main diet, and it was amusing, indeed, when their food was brought, to see the downy little fellows rush and tumble over each other in their eagerness to get at it. If a mouse was given to them it would first be put through a bone-breaking process and then swallowed. Small birds would be thoroughly picked and then swallowed head first.

After they became able to fly about, they were taken from the box in which they had been kept and put into the apple trees growing in my yard to shift for themselves. But they refused to shift; on the contrary, seemed to consider themselves as a part of the family, and for weeks remained about the yard, and in the dusk of the evening would come at once on being called, sometimes from the mill a hundred yards away, or from the trees across the river.

A very interesting feature connected with these little Scops was the manner in which they were treated by the other birds of the vicinity. About once a day the birds would assemble to harass and scold them, the usual time being a little before sundown. At a signal, generally from the Robin, they would come from all direc-

tions—the Jay and the Purple Grackle from their nests in the apple trees; the Rose-breasted Grosbeak from the top of the hackberry; the Cardinal and Wood Thrush from the box elders across the river; the Orioles from their swinging nests in the elm and sugar maple; the Bee Martin and Warbling Vireo from the silver-leaved; the Jenny Wren from the eaves of the portico; the Cat-bird and Brown Thrasher from the gooseberry bushes, and the Maryland Yellow Throat from his nest in the thick weeds on the river's bank—all would come to devote a few minutes to scolding their common enemy.

The Jay, the Grackle, the Cat-bird, and the Robin would do the aggressive business, while the other birds, from a respectful distance, would be the spectators. The Robin, in particular, would show the greatest excitement in these attacks. He would often fly down to the ground near where I sat and in the most frantic manner try to call my attention to the fact that there was a terrible owl in the apple tree.

At first these attacks almost frightened the Screechers to death; but they soon became accustomed to them, and, in fact, seemed rather to enjoy this bird matinée.

One of these interesting birds was stoned to death by a man as it was perched upon the fence near his repair-shop. Another was shot and killed by a *kind-hearted* lady that wished to display her marksmanship. A third is still about town, and his tremulous notes are often heard around my premises in the dusk of the evening.

PRIMITIVE ARCHITECTURE.

I.

Sociological Influences.

BY BARR FERREE.

FOOD and shelter constituted the first and chief wants of primitive man, and to their satisfaction he devoted his dormant energies. At first, unable to construct his own shelter, he was obliged to depend upon such as nature furnishes. The *cave* was at once the most convenient and the safest. Its universal use in primitive times

is attested by the vast number of remains and relics we find therein. Its use by the Rock Veddahs—one of the rudest races of mankind—has continued to the present day. History, however, furnishes other reasons for the use of the cave. Thus hermits affect them that they may be uncontaminated by worldly things, and the fisherman of the Yank-tse still uses them, as they are most convenient for his occupation.

As man became more accustomed to his surrounding, as his ideas became stronger and more definite, he set about building his own shelter. At first it was a mere pile of leaves and branches. If subject to a constant wind, he arranged a semi-circle of branches thrust upright into the ground, and often built a fire in the open side.[1] In a more advanced stage he builds a circle of branches, brings their tops together, and ties them with a strip of bark. But the hut is still incomplete, and remains so until the frame is interwoven with cross-branches and twigs, sometimes, as with the Fuegians, only on the windward side, sometimes, as with the Damaras, over the whole.

The shed has an origin equally early as the hut, although it was developed differently. In fact it depended on the material on hand whether this form or the other was adopted. In Australia,[2] where large strips of bark are readily obtained by the natives, a lean-to is the usual form; in Fernando Po.[3] on the other hand, a coarse matting stretched out on four poles is in universal use. The latter may be considered the normal form of shed. and we can trace its progress from these slightly inclined roofs to the elaborately finished, high-pitched roofs of the hot regions of South America.

The early habitations of man may be roughly classified as circular and rectangular. Much speculation has been indulged in as to the causes of this difference, and it is a singular fact that the two styles of dwellings are frequently found side by side in districts where there does not seem to be a natural cause for any distinction. It has been suggested that rectangular houses are characteristic of the communistic manner of living and circular ones of single families. The members of a single family can readily sleep around one fire; when several families are congregated under one roof several fire-places are required, and the house is extended, usually in one direction. While this is true, there are many circular houses occupied in common, and there are also numerous instances among the rudest

[1] Tasmanian Journal, i., 250.

[2] Angas's Aust. and N. Zealand, ii., 212.

[3] Allen and Thompson's Narrative, ii., .197

peoples of one family occupying rectangular dwellings. The truth is, that the development of both the rectangular and the circular house is merely a plain case of natural development. First, we have a simple breakwind, a single strip of bark. Then comes one on two sides, another is added, and it is only necessary to close the remaining side to complete the square. These changes can be illustrated by numerous examples, but it is only necessary to mention two; the breakwind of the Australian savage represents the first stage, and the Patagonian tent,[1] formed of skins stretched on three sides of a square, the second. The shape of the dwelling does not, as might be supposed, depend on the manner in which the logs forming the sides are laid. When horizontal, we invariably have the rectangular hut, but they are placed vertically in both rectangular and circular dwellings. Nor is the explanation difficult, for the shed, supported by upright poles, is easiest enclosed by placing logs parallel to the first, and the rectangular house with walls of vertical logs is obtained.

The manner of life is an essential element in determining the form and character of a dwelling. In the earliest times man was constantly moving, seeking new shelter, new resting-places, new food. He could carry nothing with him in his migrations, for he had no means of conveyance. He was equally satisfied with a cave or a heap of leaves. Later, when he has learned to use a few simple tools, to skin animals, to prepare their skins, and to build his hut with some little care, he carried it with him. Hence the dwellings of nomadic peoples fall naturally into the two divisions of transportable and non-transportable, and the former are again subdivided into those covered with mats and those covered with skins.

$$\text{Dwelling of Nomads}\begin{cases}\text{non-transportable}\\ \text{transportable}\quad\begin{cases}\text{Mats}\\ \text{skins}\end{cases}\end{cases}$$

Being easy of construction, mat tents are used by the rudest peoples. The Abipones pass their lives under two poles and a mat; the Zulus, standing higher in the social scale, find comfort in cages of pliant sticks, covered with finely woven rush mats.[2] Skin tents are used by more advanced races, since their use implies knowledge of the manufacture of the weapon with which to kill the animal, and of the mode of skinning and preparing the skin. They are

[1] Anthro. Jour., i., 197.
[2] Burchell's Travels in Africa, ii., 198.

used alike both by pastoral and hunting tribes, but seldom by purely agricultural ones, by the hunting Indians of North America, the Dakotas and Chippeways, by the pastoral bands of the extreme east and the far south, the Arabs and the Patagonians.

The agricultural nomads, moving less often than do the hunting and pastoral ones, build more permanent dwellings. Some, as the Gonds, move every few years. Their houses are of wattle and daub, thatched with teak-leaves; within are two rooms, separated by a row of grain baskets, or by a bamboo screen, one serving as a living room, the other for storing.[1] Greater care is shown by the Bodo and Dhimals,[2] who, in addition to the central dwelling, build a cattle-shed; and if the family is a large one, complete the quadrangle with two other dwellings. The Santals,[3] moving only when they have exhausted the soil at one place, build even a more elaborate group of buildings; a verandah is placed at the gable end, and pigstys, buffalo-sheds, and dove-cots built within the common enclosure.

Many other causes than the fertility of the soil occasion the removal of the agriculturist. The Khonds[4] abandon their dwellings on decay; the Western Kareens[5] seek new quarters on the encroachment of their enemies; while the diseases generated by the heat expel the Caribs from theirs.

Turning to communism, which is, perhaps, as early a phase of life as the nomadic, we find that it also produces numerous variations in structure. And, first of all, it is interesting to trace the origin of communism as shown in the dwelling. The protection gained by numbers led many tribes to adopt this form of life. Such, for example, are the Pueblo Indians,[6] who erect large terraced buildings, often with no opening on the ground floor. Such, also, are the Mandans,[7] an unaggressive people, brave, but unable to contend with their powerful neighbors, the Sioux. Their houses are circular, from 40 to 60 feet in diameter; the walls are of thick logs, the roof of beams supported by posts, thatched with willow-boughs and prairie grass, and the whole covered with several feet of earth and clay. Two doors of buffalo skin protect the entrance.

[1] Forsyth, Highlands of Central India, 99.
[2] B. H. Hodgson in Jour. As. Soc. Bengal, xviii., 741.
[3] Jour. As. Soc. Bengal, xx., 570.
[4] Macpherson, Report upon the Khonds of Ganjam and Cuttack, 59.
[5] Parrish in Jour. As. Soc. Bengal, xxxiv., 145.
[6] Morgan, 136.
[7] Ib., 126.

In addition the whole village is fortified. To the same cause may be attributed the peculiar villages of the Tupis, which consist of several houses arranged with their entrances opening on a common court, and the whole surrounded with a strong palisade.

The greater facilities communism affords for obtaining subsistence led the Iroquois to adopt that form of life. Those residing in villages lived in common, all partaking of the common store, while the venturous brave who went out after food lived a solitary life. To the same reason may be probably attributed the all but universal custom of communism among the North American Indians. The natives of Guiana furnish a curious variation of the women and children living in a detached cook-house.

In the far north cold has produced communism. The desire for greater warmth induced the Kamtschatdales, the Ostyaks[1] and the Esquimaux[2] to live in common during the long, cold months of winter, while light cool dwellings suffice for their abode in summer.

In studying the effect of communism on the structure of the dwellings, we note, first, that all communistic houses are very much larger than those intended for single families. They are of all sizes, from the Ojibwa wig-e-wam[3] for two or three families, up to the immense Long House of New Guinea, 30 x 300 feet and more, or the American Pueblo of a thousand rooms. As the size varies with the number of the inhabitants, so does the construction. The greater the number of people engaged in erecting a building, the greater the care taken and the better will be the materials used. Such is found to be the case with the dwellings of the Clatsops and Chinooks,[4] the walls of which are of white boards sunk in the ground, with a roof of timber fastened by cords of cedar bark and covered with two or three ranges of light poles. The Long House of the Seneca-Iroquois is another example. It is formed of a strong double frame of poles, with either a triangular or a semi-circular roof, enclosing large strips of elm bark, tied to it with strings or splints.[5] The Esquimaux furnish even a more striking instance, for the huge blocks of snow and ice used in their dwellings cannot be moved without the assistance of many men. The great care taken in the construction of communal dwellings is further shown by the use of

[1] Latham's Des. Eth., i., 454.
[2] Cook's Sec. Voyage, ii., 237.
[3] Morgan, 113.
[4] Ib., 111.
[5] Ib., 120.

larger material than is possible or even desirable in individual dwellings, as is shown in the huge pieces of bark covering the Ojibwa wig-e-wam, and the Iroquois Long House. Finally, it should be noted that communism sometimes produces remarkable changes in the appearance of the dwelling. Perhaps the most noteworthy instance is the village of the Yakut nation of Southern California,[1] consisting of a row of conical or wedge-shaped wig-e-wams, with a continuous awning of brushwood in front.

Although the changes produced by communism are of a limited nature on the exterior of the dwelling, it causes a great variety in the interior. First of all, we note variation in the number of partitions and in their construction. Some dwellings, as those of the Dakotas and of the Tupis—the latter containing from 20 to 30 families—are without any partition whatever. Others, as those of the Chinooks, have partitions in the larger houses—80 families—but none in the smaller. Then come partial partitions; some, as in the elliptical lodges of the Kutchin tribe, radiating towards a central open space; others, as in the Iroquois Long House, having side partitions only. Finally, there are complete partitions, separate cabins under the same roof. These last are found in the houses of New Guinea,[2] huge edifices containing cabins of bamboo 10 feet square, with doors at the side and a fireplace between every two cabins. The Mishmis,[3] with similar dwellings, have a fireplace in each compartment.

Quite as much variety is found in the distribution of the passageways. First, none at all, as in the Kutchin lodges; next, a straight aisle down the middle, as in the Iroquois Long House. Differing from this only in position are the houses of the Mishmis, with a passage along one side, and the Kareens,[4] who form a passage all around the house. Finally, there is a perfect maze of passages, as in the dwellings of the Brokpas.[5]

A similar evolution is found in the arrangement and number of the fireplaces. Many, as with the Powhatans and Dakotas, the Kutchins and the Mandans,[6] have but a single fire in the centre of the dwelling. Others, again, as the Iroquois[7] and the Uraupes,

[1] Morgan, 107.
[2] Jukes, Narrative of the Surveying Voyage of H. M. S. Fly, 272.
[3] Griffith in Jour. As. Soc. Bengal, vi., 333.
[4] Mason in Jour. As. Soc. Bengal, xxxvii., Pt. 126.
[5] Jour. As. Soc. Bengal, xlvii., Pt. 1, 34.
[6] Morgan, 126.
[7] Ib., 65.

arrange the fires in the central aisle, so that one fire serves for four cabins. More developed are the dwellings of New Guinea, with a fire to every two cabins, and of the Mishmis, with a fire to each cabin. Another form is found among the Mayas, who build a separate cook-house where the cooking for the whole village is done. The Ostyaks keep their food safe from the dogs in a village storehouse.

There is no more singular mode of building than that of elevating the dwelling on poles. It is of most frequent occurrence among communistic peoples, but is by no means confined to them. Its origin has been long a favorite subject for controversy among students of primitive architecture. The historians of Timor allege that it arises from the fear of the reptiles that infest that fertile island, and we are also informed that such houses are constructed at Kurrecchane that the children may sleep safely at night. However well this custom in these places may be explained by these statements, it is sufficiently obvious that the explanation is not a universal one, and its origin must be looked for elsewhere. The best theory yet proposed is that of M. Frederick Troyon,[1] but which, though it is supported by many facts, fails when put to the test of universality. Beginning with the observation that all such buildings are built over or near water, M. Troyon argues that the rafts used in the early migrations afforded little protection to their owners, especially when the men were off hunting. Safety, however, was readily obtained by mooring in midstream, while, when pulled ashore, the raft was best kept from being washed away by the waves, by being elevated beyond their reach. Unfortunately for his theory, however, M. Troyon has ignored the fact that elevated houses are to be found both on the coast line and in interior districts where rafts would be impractical. Other and possibly many causes have contributed to the custom; among them especially the desire for greater protection. It is not sufficient for the Sumatrans[2] that they hide their dwellings amid the trees on a hill-top, to which there is but one, or at most two, narrow paths of access, nor is a high and strong fence enough. They elevate their houses on posts and enter by means of movable notched poles. The theory of protection is confirmed by the solitary houses being more elevated than are the village houses. If the custom of building elevated houses

[1] Troyon, Habitations Lacustres des temps anciens et modernes. Lausanne: 1860.

[2] Marsden, History of Sumatra, 56.

originated with the natural fear of man for his race, then, in houses built over the water, the land side should be the strongest portion of the building, while the water side should be open or only lightly constructed. This is found to be the fact in the houses of New Guinea,[1] which have a stage on the water side that affords a convenient place for keeping the canoes. A confirmation of this explanation is seen in the custom of many maritime tribes of placing their dwellings where embarkment is attended with the greatest difficulty. Again, this mode of building is found prevalent among both warlike tribes, as the northern Kareens, and peaceful ones, as the Mishmis. All such instances point in the direction of the same cause; that they may better defend themselves against their enemies.

But greater protection is not the sole reason for the building of elevated houses. High floods make it imperative, as with the Waraus, or else drive the natives to elevated bits of land, as in the basin of the Orinoco. Tribes living near the coast and supporting themselves by fishing adopt this style of dwelling almost exclusively, while interior tribes prefer houses built directly on the ground. This distribution is especially marked in the East Indies.

Besides acting as an integral factor in producing communistic and elevated dwellings, the desire for better protection has brought about many other variations in structure. The location of the village is frequently selected with this end in view. Sometimes the hill-top is chosen, as by the Maiwar Bhils—who have a back door conveniently arranged for flight; with others the most secluded valleys are sought, as is done by the Santals;[2] others, again, hide their dwellings in clumps of trees. Some, also, as the Khonds,[3] place their villages in close proximity to each other, while the Bushmen[4] take the opposite course of building in high open spots where they cannot be attacked without warning.

A suitable site selected, the next step is to defend it. This leads to a judicious arrangement of the dwellings; a favorite plan being a circle with the entrances opening towards the central space, which is usual among the Andamese, the Bushmen, and the Kaffirs. When the chief of the village has developed into an important personage, his dwelling, for greater safety, is placed in the centre of the enclosing village. The Rajput and Bihé villages are illustrations of this fact.

[1] Forrest's Voyages, 95.
[2] Jour. As. Soc. Bengal, xx., 569.
[3] Campbell, Wild Tribes of Khondistan, 49.
[4] Burchell, Travels into the Interior of Southern Africa, ii., 55.

The mere arrangement of the houses does not, however, furnish sufficient protection to the timid or the warlike tribes. Artificial fortifications must be raised. These are of two general kinds, those intended for the whole village and those only for single houses. The former include palisades, sometimes erected at the end of the street, as in the Khond villages, and as is usual in Africa, sometimes continued around the whole settlement, when it becomes a wall. The second class includes a great variety of expedents, dependent, chiefly, upon the ingenuity of the builder. Some, as in New Caledonia, are satisfied with building a fence close to their dwellings; others, as the Angain Nagas, surround themselves with a stone wall; others, again, as the New Zealanders, barricade their doors and windows with strong bars.

Rank and wealth have their influence upon dwellings. This is chiefly to be seen in their construction and size. The poor of every society, the lowest as well as the highest, live in meaner houses than do the wealthier classes. Not only will a rich man's house be larger than a poor man's, but in warm climates it will consist of more parts. The wealthy Kalmuck has a separate cooking tent, and the palace of a Javanese prince resembles a walled city.

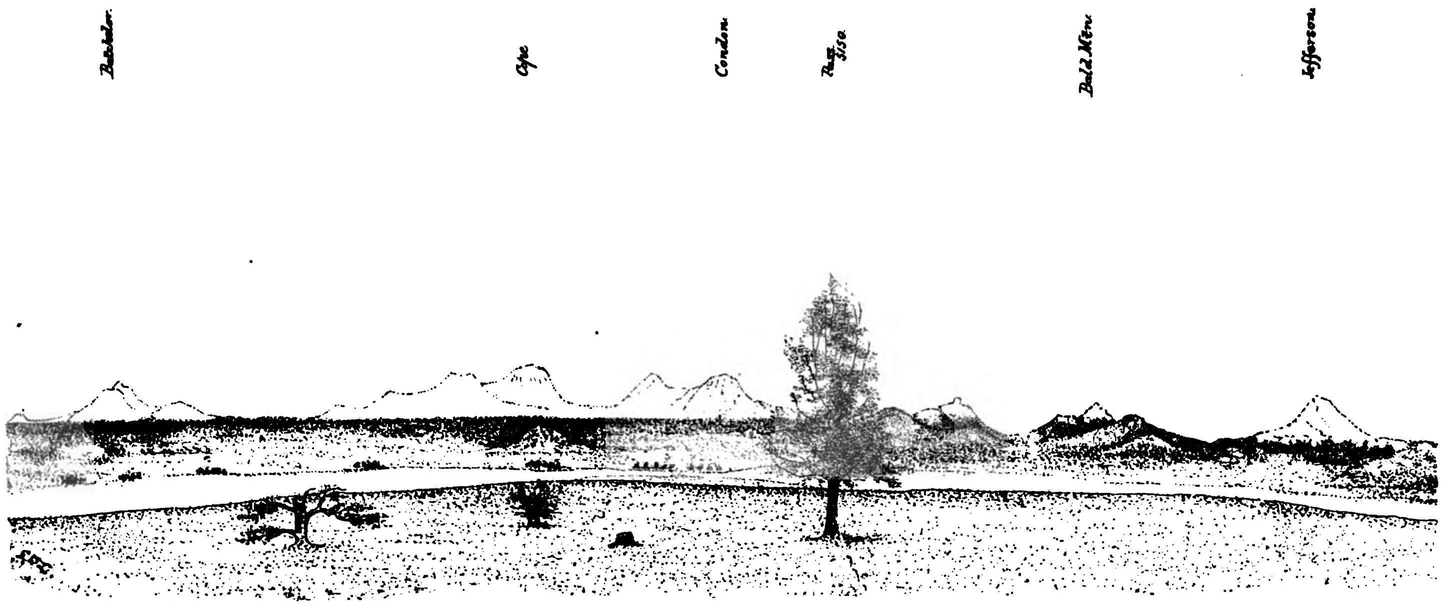
Rank is further indicated by sundry external forms; for example, by the height of the dwelling, the elaboration of ornament, the shape and number of the roofs. The house of a Javanese chief has eight roofs, while the mass of the people are restricted to four.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The American Society of Naturalists at its recent meeting in Baltimore passed a resolution which requests its Executive Committee to consult with the corresponding representatives of certain other scientific bodies as to the next time and place of meeting. The societies referred to are all newly organized, and are: The American Physiological Society, the Society of Anatomists, and the American Geological Society. One of these, the Geological Society, arranged to meet during the Christmas holidays at Ithaca, N. Y., and it was stated that several of the geological members of the American Society would probably prefer to attend the meetings of

PLATE XXI.



Part of the Cascade Range.

the Geological Society should they be held contemporaneously in future. It was also plainly seen that the multiplication of societies would reduce the membership of the body then in session at Baltimore, and a remedy for such contingency was proposed and discussed.

The proposition is that the four societies hold their meetings in future at the same time and place, so that the members of one of them can have the advantages of the others. The plan was generally acceptable to the members of the American Society, and it is to be hoped that it will be so to the other societies as well. Such an arrangement has much in its favor, and the only objection arises from the slight difficulty to be experienced in making the preliminary and local arrangements. The existence of so many societies necessarily diminishes the strength of each one, since few naturalists can hold, for various obvious reasons, a membership in more than one of them. The co-operation of these societies once obtained, the result will be beneficial to American science. It will be, in fact, a national scientific body intermediate in character between the National Academy and the American Association. Such a body will produce a distinct impression on the energies of its members, as well as on the attention of the public. If the membership is properly guarded, it will have a distinctly valuable influence on the administration of scientific trusts of all kinds. That the membership can be guarded we fully believe, since the American Association is the popular body and furnishes every opportunity for expansion in that direction. The new body would furnish a winter meeting for naturalists of all departments, under the influence of a festive season, in every way well calculated to encourage and stimulate them in their often locally isolated labors. We hope that the three societies named will take this view of the subject, and that next winter will see a combined meeting of all of them at some accessible point.

THE NATURALIST informs its readers that it commences the year 1889 with a new department, that of Bacteriology, under the editorship of Professor W. T. Sedgwick, of the Institute of Technology, Boston. The department of Physiology will be edited by Professor Frederick S. Lee, of Bryn Mawr College, Pa.

The numbers of the NATURALIST for 1888 were issued on the following dates: January, Feb. 3; February, April 2; March, April 21; April, May 25; May, June 29; June, Aug. 8; July, Aug. 30; August, Sept. 30; September, Oct. 24; October, Nov. 22; November,

Dec. 13; December, Dec. 26. Postal delays caused the omission of some plates from the December number. These will be issued with the January and other numbers of the present year. Haste in the printing of the December number caused the numerous typographical errors which it contains, and neither authors nor editors are responsible for them. The publishers have made new arrangements for printing, so that the delays in issuing the magazine to subscribers, and separate copies to contributors, will not again occur.

ERRATA.—In November number, p. 955, fourth line from bottom, for 1700 read 700. Do., p. 997, for 1,600,000 read 160,000. Do., p. 1029, for *Clione* read *Cleome*. In December number, p. 1073, for *Septocladus* read *Leptocladus;* do., Plate xxvii., for *facies* read *brevifacies*.

RECENT LITERATURE.

THOMAS' BURIAL MOUNDS.[1]—To one who, like the present reviewer, received most of his archæological knowledge at the feet of that most accurate student of the American Indian within the historic period, Mr. Lucien Carr, of Cambridge, Dr. Thomas' monograph appeared like an old friend. There is, indeed, much new material, and a new presentation of old facts, but there is, too, the same conclusion which we have been led to hold as true: that those mounds which dot our Western and Southern States and which have given rise to such an amount of speculation and hypothesis, were built by the Indians in possession of that region within the historic period or by their ancestors. The facts brought out by Mr. Carr in his essay on the "Mounds of the Mississippi Valley Historically Considered" have not been controverted, and the present paper but adds to the evidence that there is no necessity for invoking the aid of a special race of "Mound-Builders" distinct from the Indians found in possession of the eastern half of the United States at the time of its discovery.

Dr. Thomas takes up the subject in the following order: (1) Burial Mounds of the Wisconsin District; (2) Burial Mounds of the Illinois District; (3) The Ohio District; (4) The Appalachian District; (5) The Cherokees probably mound-builders; (6) Concluding remarks; while in a supplementary note he gives an account of the burial customs of the Hurons, translated from the pages of the martyred Brebeuf in the "Relaçion" of 1636.

In the cases of the mounds of Wisconsin as well as of those of the Illinois district (including Northern Illinois, Eastern Iowa and

[1] Burial Mounds of the Northern Section of the United States. By Cyrus Thomas. Extr. Fifth Annual Report of the Bureau of Ethnology. Washington, 1888, pp. 119.

Northeastern Missouri) it is clearly shown that the historic Indians did build burial mounds, but in the case of Ohio this is not so easy. History and tradition tell us almost nothing of the aboriginal inhabitants of that State, for soon after the advent of the French in the new world, the Iroquois rendered that whole region an uninhabited wilderness. It is true that we have references to the Eries or Cat nation and legends of the Tallegwi, but what the affinities of these tribes were, history tells us nothing. Dr. Thomas, however, compares the Ohio mounds with those near Charleston, West Virginia, and gives much evidence to show that both were made by the same people and more than suggests the identity of the Tallegwi with the Cherokees. These latter are shown beyond much possibility of doubt to have been a mound building people even in post-Columbian times. Among the other conclusions drawn may be mentioned these: That there is no evidence of human sacrifice in mortuary rites; that nothing indicates that the people building the mounds had arrived at any higher culture-status than had some of the historic Indian tribes of the same region; and that the period of mound-building could not have continued for more than a thousand years, and hence its commencement probably does not antedate the fifth or sixth century.

COMSTOCK'S ENTOMOLOGY.[1]—This work is nearer our ideal of what a text-book of entomology should be than anything, American or foreign, which has appeared for many years. It is concise, clear, and bears evidence of careful preparation and abundant knowledge, while most of the illustrations are new and fresh, many being engraved by Mrs. Comstock expressly for the work. In the present part the subjects treated are (1) The Characters and Metamorphoses of Insects, (2) The Anatomy of Insects, (3) The Orders of Hexapoda, (4) Thysanura, (5) Pseudoneuroptera, (6) Orthoptera, (7) Physopoda, and (8) Hemiptera. In the second part (which we sincerely hope may not be long delayed) the remaining orders will be taken up, and with them we are promised chapters on economic entomology, directions for collecting and preserving insects, a bibliography, a glossary, and an introductory chapter.

In the treatment of the different orders we notice a lack of uniformity; in some analytical tables extending down to genera are given, while others are treated less fully. This is doubtless owing to the present state of entomological science, and those groups which are left in the more imperfect condition are just those where there remains work for the systematist. We are glad to see that only the Hexapods are included, for the Myriapods are at best an uncertain group, while recent investigations have shown that the Arachnida, aside from being Arthropods, have no relationships with either Hexapods or Myriapods. With the sequence of orders some fault might be found. A division of Hexapoda above Thysanura into

[1] An Introduction to Entomology. By John Henry Comstock. Ithaca, N. Y.: published by the Author, 1888. [Pt. I., pp. 234, with 201 figures.] $2.00.

Ametabola and Metabola is convenient, but it accords too high a rank to an adaptive feature. Complete metamorphosis is but a comparatively recent introduction in the life of insects, and with it as a basis forms closely allied in structure are necessarily widely divorced. Again, in our opinion, the Orthoptera are clearly lower than the Pseudoneuroptera, a view which is not negatived by palæontological evidence nor by embryology.

We notice a few slips which can readily be corrected in the promised introduction. On the first page the author writes "Vermes" where he clearly means "Annelida," and the unnatural group of Tracheata is referred to on the same page. On the seventh page chitine is stated to be deposited "in" the body-wall. On the eighth page it is stated that the eyes may possibly be modified legs, a view which is completely negatived by embryology. On the twenty-third page the sting of certain insects should have been stated to be a modified ovipositor. Perhaps the greatest omission of all is the absence of any account of the embryology of Hexapoda. Still these, with the exception of the last, are minor points, and this exception we hope to see rectified before the volume is completed. As a whole, the work is of great value. The illustrations and descriptions will make it a true guide to the young student of insects, the accounts of noxious insects will aid the agriculturist and horticulturist, and we venture the prediction that it will be the most often referred to of any book on the shelves of the working entomologist.

RECENT BOOKS AND PAMPHLETS.

Abstracts of the Proceedings of the London Geological Society. No. 515.

Agassiz, Alexander.—Annual Report for 1885–86 of the Curator of the Museum of Comparative Zoology at Harvard College. From the author.

Allen, Harrison.—On the Methods of Study of the Crowns of Human Teeth, Including their Variations. Reprint from the Dental Cosmos for June, 1888. From the author.

Auld, R. C.—Breeding the Black-Skins. Reprint from the Breeder's Gazette, March, 1888. From the author. .

Bean, Tarleton H.—Report on Fishes Observed in Great Egg Harbor. Extract from Bulletin of U. S. Fish Commission, 1887. From the author.

Bodington, Alice.—Micro-Organisms as Parasites. Reprint from the Journal of Microscopy and Natural Science. From the author.

Boulenger, G. A.—Description of a New Snake (Sytorhynchus ridgewayi) from Afghanistan. Ext. from Annals and Magazine of Natural History, Dec., 1887.—On the Affinity of the North-American Lizard Fauna. Reprint from the Annals and Magazine of Natural History, Nov., 1887. From the author.

Brown, Henry H.—Alatypes or Stenotypography. From the publisher.

Dame, L. L., and Collins, F. S.—Flora of Middlesex County, Mass. From the authors.

Dickerson, Edward N.—The Telephone Appeals.

Du Bois, A. J.—Science and the Spiritual. Reprint from the New Englander and Yale Review for May, 1887. From the author.

Dugès, A.—Erpetologia del Valle de Mexico. From the author.

Dulles, Charles W.—Report on Hydrophobia. Reprint from Transactions of Medical Society of the State of Pennsylvania, 1888. From the author.

Emmons, Samuel F.—Atlas to Accompany a Monograph on the Geology and Mining Industry of Colorado. From the U. S. Geological Survey.

Everman, Barton W., and Jenkins, Oliver P.—Notes on Indiana Fishes. Proceedings of U. S. National Museum, 1888. From the author.

Fürbringer, Max.—Untersuchungen zur Morphologie und Systematik der Vogel. I. Spezieller Theil. II. Algemeiner Theil.

Garman, Samuel.—The Rattle of the Rattlesnake. Ext. from the Bulletin of Harvard Museum of Comparative Zoology. Vol. XIII., No. 10. From the author.

Gaudry, Albert M.—Sur les Dimensions Gigantesque de quelques Mammifères fossiles. Extrait des Comptes rendus des séances de l'Académie des Sciences, t. CVIII., 1888. From the author.

Gilbert, C. K.—Statistics of the Philosophical Society of Washington, from its Foundation. From the author.

Gray, Asa.—Synoptical Flora of North America. The Gamopetalæ. From the Smithsonian Institution.

Günther, Albert.—Report of the Challenger Expedition, Vol. XXII., Zoology. From the author.

Hampden, John.—Letter to Professor Huxley. Letter to Canon Driver, 1886. Letter to the Presidents of Literary, Philosophical, or Christian Institutions. From the publishers.

Herrick, C. L.—Bulletin of the Scientific Laboratories of Denison University, Vol. III. From the author.

Higley, W. K.—Reptilia and Batrachia of Wisconsin. Reprint from Transactions of Wis. Acad. of Sciences, Arts, and Letters. Vol. VII. From the author.

Hutton, F. W.—Notes on the Mueller Glacier, New Zealand. From Vol. III. (2d Series) of the Proceedings of the Linnean Society of New South Wales. (May 31, 1888.) From the author.

Hill, Robert T.—Notes on Geology of Western Texas. Reprint from Texas Geological and Scientific Bulletin. From the author.

James, U. P., and James, Joseph F.—On the Multiculiporoid Corals of the Cincinnati Group, with a Critical Review of the Species. Reprint from the Journal of the Cin. Soc. Nat. Hist., Jan., 1888. From the author.

Jordan. David Starr.—A Brief Account of the Darwinian Theory of the Origin of Species. From the author.

Kimball, James P.—Annual Report of the Director of the Mint for 1887. From the author.

Macloskie, Prof.—Scientific Speculation. Reprint from the Presbyterian Review, Oct., 1887. From the author.

Mosley, E. L.—Lists of the Mammals, Birds, Birds' Eggs, and Desiderata of Michigan Birds, of the Kent Scientific Institute. From the author.

Newton, Alfred.—Early Days of Darwinism. Reprint from Macmillan's Magazine, 1888. From the author.

Prosser, Charles S.—The Section of the Morrisville Well. The Upper Hamilton of Chenango and Otsego Counties, New York. Reprint from Proceedings of A. A. A. S., Vol. XXXIV.

Report of the Pennsylvania State College for the Year 1887. Part II. Report on the Condition of Tropical and Semi-Tropical Fruits in the United States in 1887. Bulletin No. 1. From Department of Agriculture.

Riley, C. V.—On the Luminous Larviform Females in the Phengodini. Reprint from Report of British Ass., 1887. From the author.

Scott, W. B., and Osborn, Henry F.—Preliminary Report on the Vertebrate Fossils of the Uinta Formation, collected by the Princeton Ex. of 1886. Read before the Philosophical Society, Sept. 2, 1887. From the authors.

Scribner, F. Lamson.—Report on the Experiments Made in 1887 in the Treatment of the Downy Mildew and the Blackrot of the Grape-Vine. From the Department of Agriculture.

Sedgwick, W. T., and Bartlett, S. R.—A Biological Examination of the Water Supply of Newton, Mass. Read before the Society of Arts, Jan. 12, 1888.

Shufeldt, R. W.—Observations upon the Morphology of Gallus bankiva of India. Reprint from the Journal of Comparative Medicine and Surgery, Oct., 1888. Contributions to the Comparative Osteology of Arctic and Sub-Arctic Water-Birds. Part I. Reprint from the Journal of Anatomy and Physiology, Vol. XXIII.

Taylor, Edgar W.—Geology in our Public Schools. Reprint from American Geologist. From the author.

Thomas, Charles Hermon.—Graduated Tenotomy in the Treatment of Insufficiencies of the Ocular Muscles. Reprint from Transactions of the Philadelphia County Medical Society, March, 1888. From the author.

Tuckerman, Frederick.—Observations on the Structure of the Gustatory Organs of the Bat (Vespertilia subulatus.) Reprint from the Journal of Morphology, Vol. II., No. 1, July, 1888. The Anatomy of the Papilla Foliata of the Human Infant. Reprint from the Journal of Anatomy and Physiology, Vol. XXII. Both from the author.

Waring, Charles B.—Genesis I. and its Critics.—Miracle, Law, and Evolution. Reprints from Transactions of the New York Academy of Sciences, Vol. VII., No. 7. From the author.

Whiteaves, J. F.—On some Fossils from the Hamilton Formation of Ontario, with a list of the species at present known from that formation and Province. Reprint from Canada Geol. Survey. From the author.

Winchell, Alexander.—Some Effect of Pressure of a Continental Glacier. Reprint from the American Geologist, March, 1888. From the author.

Winchell, Alexander.—The Taconic Question. Reprint from the Am. Geol., June, 1888. From the author.

Winchell, Alexander.—Ignatius Donnelly's Comet. Reprint from the Forum, Sept., 1887.

Woodward, A. Smith.—Note on the Occurrence of a Species of Onychodus in the Lower Old Red Sandstone Passage Beds of Ledbury, Herefordshire. On the Cretaceous Selachian Genus Synechodus. Extracts from Geol. Mag., Vol. V., No. 11, 1888. From the author.

Yorkshire Philosophical Society. Annual Report for 1887.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

ASIA.—According to a letter in a recent number of the *Revista de Geografia Comercial*, the population of the Philippine Islands is very unequally distributed, since while there are sections which, without being the most fertile, contain 223 inhabitants to the square kilometre, other sections, and these among the most fertile, have only three or four inhabitants to the same area. According to the same periodical, the sanitary conditions of the port of Paraqua Island (*Puerto-Princesa*) have become much more favorable since the forest, which formerly extended to the coast, has been cut down for a width of six kilometres, and the cleared space has been occupied with plantations of coco palms, plantains, and cacaos.

Paraqua is the third in size of the Philippine Islands, and measures 445 kilometres in its greatest length, by 44 in its greatest width. Upon its coasts are many excellent and well-sheltered ports and bays, the principal of which are Vyalampaya, Puerto-Princesa, and Ulugan. A range of mountains, the culminating points of which are Montalingahan (2.080 m.) on the S., and Victoria (1.372 m.) more to the N., parts the island into two parts. Rich alike in fertile soil and in valuable woods, this island has hitherto been greatly neglected by its owners. Its population does not exceed 28,000—viz.: 10,000 Christians in the N.; 6000 Mahometans on the S., about 6000 Tachanuas, 500 negritos, 1500 tandalanos, and 4000 manguianes.

EASTER ISLAND.—The *Revista de Geografia Comercial* (Nov. 15, 1888) states that the Republic of Chili has resolved to annex Easter Island, which was discovered by Juan Fernandez, and which in 1470 was formally taken possession of in the name of King Charles III., of Spain. Easter Island is of triangular form; 35 kilometres in circuit, and its highest point in the extreme northwest is 597 metres above the sea. It is emphatically a land of extinct volcanoes; one of these is placed at each angle; Kau on the south, Horni on the north, and Utuiti on the east. There are many other smaller volcanoes. The volcano Kau has an elevation of 408 m. and its crater, which is 200 m. deep and 1500 m. in diameter at the bottom, is remarkable for the regularity of its shape. In the bottom of this crater there are springs of potable water and fine plantations of sugar-canes and plantains.

[1] Edited by W. N. Lockington, Philadelphia, Pa.

The inhabitants are probably not more than 200 in number. The average height of the men is 1.57 m., that of the women, 1.50.

Easter Island is celebrated for its gigantic statues which the natives call *moai*, and also contains ruins of houses, vast platforms, and cemeteries. The statues represent the upper part of the body as far as the hips, with the arms united to the sides, the hands embracing the hips, and the face with a disdainful expression. They are carved from a compact gray lava which abounds in the crater of Utuiti, but have crowns of red lava of conical shape and about three feet in height. Most of these statues are from fifteen to nineteen feet in height, but some are much larger, notably two which are stretched upon the ground near Utuiti. In one of these the body alone is 12 m. high, and the nose 3.40 m. The interior of the crater of Ronororaka contains forty of these statues, all with the face turned towards the north; and the summit of this mountain seems a great workshop of unfinished statues. One of the platforms, on the south coast, is .9 m. high, and 100 m. long, is enclosed with a wall, and contains numerous overthrown statues as well as some low columns which apparently served as altars. The cemeteries (Papakoo) are double platforms, the upper one containing sepulchral chambers. Wooden slabs with hieroglyphics exist upon the island, but no one can decipher them, so that the origin of the huge ruins is unknown. There is, however, great similarity between the statues and the sculptures of the Aymaras of Peru.

JAPAN.—According to the first official statistics published by the Japanese Government, the empire contains 381,845 square kilometres, and has a population of 38,151,271. The number of men greatly exceeds that of the women, and divorces are so numerous that they amount annually to 3 in every 1000 inhabitants The mortality is low compared with that of most European countries, since it is only 19 per 1000. Japan has 721 towns with more than 2000 inhabitants, and five of more than 100,000—viz.: Tokio, 912,837; Osaka, 353,970; Kioto, 235,403; Nogoya, 126.898; and Kanakasa, 104,020. The production of tea each year is about 23,000,000 of kilograms and that of silk 3,000,000 of kilograms. The amount of rice, wheat, barley, sugar-cane, and other agricultural products, is such as to prove that either the soil is superior to that of Europe, or that it is better cultivated. The very considerable extent of forest that still remains may perhaps partially explain the fertility. Two hundred and fifty-six telegraphic and 92 telephonic offices exist in the empire. A carpenter earns about 35 cents a day, a stone-mason about 44 cents.

AMERICA. CASSIQUIARE.—The *Revista de Geografia Comercial* dissects sarcastically the *discoveries* of M. Chauffanjon in the region of the Upper Orinoco. If the *Revista* is correct, and it certainly fortifies its assertions with names and dates, M. Chauffanjon's achievements are similar to those of the immortal Captain Glazier. The

Revista states that in 1743, the Jesuit P. Roman passed along the Cassiquiare from the Orinoco to the Rio Negro; that Diaz de la Fuente and Bobadilla followed the Orinoco nearly to its source and 87 leagues above the separation of the Cassiquiare; that the Marquis of Socorro, with Hurriage and other commissioners deputed to fix the boundaries of Brazil, found the latitude and longitude of the point of origin of the Cassiquiare, and calculated its altitude at 337 Spanish yards above sea-level; and that the mountains which M. Chauffanjon has rebaptized bear the title of Parima, though in different portions of their extent they are called Tapiraperú, Patuibiri, Arihuana, Maritani, Humirida, Pacaraima, etc.

Geographical News.—The principal articles of export from Spain, besides wine, are iron, copper, lead, cork, and oranges. The values of these articles during the first four months of 1888 were, according to the *Revista de Geografia Comercial*, respectively $2,166,000, $2,921,000, $1,626,000, $3,363,000, $1,351,000, and $1,783,000. The value of wine exported during the same four months was $20,466,800.

A project to run a line of steamers between Vigo and New York has been set on foot by the Spanish Chamber of Commerce at the latter place. Vigo is only 60 miles further from New York than Queenstown, and is 231 miles nearer than Havre. The lower latitude, independent route, and comparative freedom from fog and wind, will more than compensate for the slightly increased distance.

The Manchester ship canal, now in course of construction, will be 35 miles long, the width varying from 170 to 260 feet at the top, a width at the bottom in no case less than 130 feet, and a minimum depth of 25 feet. The contract is let for £5,750,000, but the company has a subscribed capital of £8,000,000. The opening of this canal will practically make Manchester a seaport. As the city with its suburbs contains 850,000 souls and will be geographically the nearest port for 7,000,000 of people, the construction of this canal cannot but be injurious to Liverpool.

The province of Santandar, Spain, contains in operation 360 zinc mines, 312 iron mines, 30 lead, 19 copper, and 17 coal mines. Less than a fourth part of its area is cultivated, and rather more than a fourth is in pasture.

The population of Belgium, according to the census of Dec. 31, 1887, amounted to 5,974,000.

GEOLOGY AND PALÆONTOLOGY.

Fish Otoliths of the Southern Old-Tertiary.—In a recent article[1] Dr. E. Koken in Berlin describes the fish otoliths collected by Dr. Otto Meyer in the Old-Tertiary of Mississippi and Alabama. The locality "Jackson River" of Mr. Koken ought to be "Jackson, Miss.," and the locality "Newton, Miss.," cannot be considered as belonging to the Vicksburg beds. Changed accordingly, Mr. Koken's table of species is given below.

	Claiborne, Ala.	Newton, Miss.	Jackson, Miss.	Vicksburg, Miss.
Otolithus (Carangidarum) americanus......			+	+
" (Apogonidarum) hospes..........			+	
" (Pagelli) elegantulus.............			+	
" (Sparidarum) insuetus............			+	
" (Sciænidarum) radians...........				+
" " gemma...........			+	
" " eporrectus........		+		+ and Red Bluff, Miss
" " claybornensis.....	+		+	
" " intermedius.......	+			
" " similis............			+	
" " decipiens..........	+			
" (Trachini) lævigatus.............			+	
" (Cottidarum) sulcatus............			+	
" (Triglæ) cor....................			+	
" (Cepolæ) comes..................			+	
" (Mugilidarum) debilis............			+	
" (Gadidarum) meyeri.............			+	
" " elevatus............	+			
" " mucronatus........	+			
" (Platessæ) sector.................	+		+	+
" (Soleæ) glaber....................			+	
" (Congeris) brevior................			+	
" (incert. sedis) aff. umbonato......		+		

We see that Mr. Koken has succeeded in determining the genera or families of all fishes which are represented by these ear-bones, with the single exception of one worn specimen from Newton. The enumerated families and genera indicate a strictly litoral fauna, no abyssal form is among them. It is different in its character from the fish fauna of the German Tertiary, which has been studied also

[1] "Neue Untersuchungen an tertiaeren Fisch-Otolithen." Zeitschrift d. deutsch. geolog. Gesellsch., 1888, p. 274, 8 plates.

by Mr. Koken from the otoliths, but resembles in general the present fauna of the Gulf of Mexico, of the West Indies, and the Southern coasts of the United States. The dissimilarity of the fish faunas on both sides of the Atlantic existed, therefore, already during the earlier Tertiary. We are indebted to Mr. Koken for having developed an entirely neglected subject, the study and determination of fossil fish otoliths, to such an extent that important conclusions can be derived.—*O. Meyer.*

CATALOGUE OF FOSSIL REPTILIA AND BATRACHIA OF THE BRITISH MUSEUM Pt. I., by Dr. Lydekker. In this volume we have what has been long needed, a synopsis of the fine collection of British and such other European extinct reptiles of the orders Ornithosauria (Crocodilia), Dinosauria, Squamata. and Rhynchocephalia, which is embraced in the national museum of Great Britain. This synopsis is, like its predecessors, systematically arranged, and the text is enlightened with comments on the structural relations of the forms embraced in it. Many of the forms, especially of Dinosauria, described by English authors, have been hitherto in a state of obscurity to foreign observation, and a great deal is done in the present volume towards clearing this away. Especially valuable are the diagnoses of families and genera of the Crocodilia, in which the mesozoic formations of Europe are so productive. While we accord generally with the systematic views expressed by Dr. Lydekker, we must point out a few points of divergence. We cannot perceive the *raison d'etre* of an order Proterosauria. which the author, indeed, seems to regard as provisional. We do not believe that the Opisthocœla (Sauropoda) is distinguishable as an order from the Crocodilia. In nomenclature, we find the two divisions of the true Dinosauria to accord exactly with our own, and not with those of Professor Marsh, yet the names of the latter author are adopted. As usual, we find some generic names adopted, which were never characterized, as Trachodon instead of Hadrosaurus. Finally, we must make an appeal on behalf of the name Belodon for the genus usually so called, as against the prior name of Phytosaurus. Phytosaurus for an entirely carnivorous animal is a gross misnomer, and is nauseating to the scientific stomach. Not only this, but the typical specimen exhibits only mineral casts of the pulp cavities in place of teeth, so that name belongs to mineralogy rather than to palæontology. In case Belodon has been previously otherwise used, there are other available names, as Centemodon Lea, for instance.

In concluding this review, we must record our appreciation of the author's method of clear definitions for all divisions he proposes and adopts, a custom which is the necessary basis of all good taxonomic work.—*E. D. Cope.*

GEOLOGICAL NEWS.—GENERAL.—M. M. Bertrand (*Bull. d. l. Soc. Geol. de France*, No. 7, 1888) endeavors to reconcile the oppo-

site views of French and German geologists relative to the relations between the structure and age of eruptive rocks. While French geologists have, by long study of the eruptive rocks of France, come to the conclusion that their structure shows indubitable traces of the youth, maturity, and old age of the earth, the German school has from its studies concluded that there is no relation between the structure of eruptive rocks and their age, but that all varieties may have been produced at any time in the world's history. Mr. Bertrand believes that the fact that, in the Tertiary period, a series of ancient textures reappeared in consequence of the long period of repose that preceded that period, may be brought in to reconcile the two beliefs. If there was one such recurrence, others, greater or less, may have occurred from similar causes. Still, M. Bertrand believes that there are variations between these recurrences, and sets himself the task of explaining them.

"All the eruptions of the same period (in Europe) are grouped around their corresponding chain, the most ancient around the Caledonian or in the more northern regions; those of the Permian and Carboniferous around the Hercynian chain, those of the Tertiary round the Alps. If the entire globe is studied, at every age rocks of all compositions and structures will be found, which bears out the idea of the German school; but if the same zone is studied, details of structure in relation with the age of the rocks can be found."

M. Bertrand considers the continent of Europe to be formed of four zones, each of which exhibits its series of folds. These zones are: (1) the Huronian, which has its principal European extension in Russia, Finland, and Sweden; (2) the Caledonian, which occupies Ireland, Wales, Scotland, and Norway, thus introducing itself wedge-like into the sinuous outline of the Huronian; (3) the Hercynian or Carboniferous, the northern edge of which, in both Europe and America, is marked by a line of coal measures; (4) the Alpine, comprehending the Pyrenees, Alps, Carpathians, and Balkans. By a curve in its outline the Hercynian mass takes in the Asturias and the central plateau of Spain. Mr. Bertrand gives diagrams of the distribution of the zones in Europe, of their folds, and of the masses of eruptive rocks connected with them, and enters into details regarding the separate masses.

PALÆOZOIC.—Charles Barrois notes the presence in the Pyrenees of a species of Oldhamia found in the palæozoic schists in the department of Haute-Garonne. The new species is named *O. hovelacquei*. The presence of this species, distinct from *O. antiquus*, discovered by Oldham in Ireland in 1844, proves the existence of the Cambrian age in the Pyrenees.

M. D. P. Oehlert describes some Devonian Acephala (Aviculidæ) found in the Devonian strata of France. Three new forms of Pterinea, five of Avicula, one of Palæoneilo, and two of Modiomorpha are added to those previously known.

MESOZOIC.—M. Deperet (*Bull. Soc. Geol. France*, No. 7, 1888) treats of a brackish-water horizon in the Huronian; and describes a new species of Cassiope, one of Cerithium, and one of Corbula from it. The horizon occurs at La Mede and Callauch, near Marseilles.

M. H. E. Sauvage (*Bull. Soc. Geol. France*, No. 7, 1888) describes the reptiles of the Upper Portland series of Boulogne-sur-Mer. These include *Megalosaurus insignis*, *Iguanodon prestwichii Caulodon precursor*, a Dinosaurian not yet named; three chelonians, two crocodilians (*Machimosaurus interruptus* and *Goniopholis undidens*), an Ichthyosaurus near to *I. thyreospondylus*, and two Plesiosauri.

The Cretaceous region of the southwest of France presents (*Bull. Soc. Geol. de France*) characters strongly contrasting with those of the Jura, Pyrenees. and Brittany. The beds offer both vertical and horizontal continuity, the country not having experienced the disturbances of other Cretaceous basins. There is a considerable hiatus between the Jurassic and the Cretaceous of the southwest of France. The Wealden, Neocomian, Urgonian, Aptian, and Gault are absent, the Cretaceous sea did not invade this region until the Cenomanian period. The Turonian and Danian are present.

Louis Dollo (*Ann. Soc. Geol. du Nord*, July–Aug., 1888) states that *Pachyrhynchus* Dollo, *Erquelinnesia* Dollo, and *Glossochelys* Seeley, are equal to *Euclastes* Cope.

TERTIARY.—M. Gosselet (*Ann. Soc. Geol. du Nord*, July, 1888) disputes some of the conclusions of Prof. Prestwich regarding the correlation of certain Eocene beds of England with those of Belgium and the north of France, and proposes a table in place of that drawn up by Prof. Prestwich. M. Gosselet believes, contrary to the opinion of Prof. Prestwich, that the London clay is represented in the basin of Paris.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—In a recent number of *Tschermak's Mittheilungen*[2] Mr. Hyland gives a most interesting and detailed account of the lavas of Kilimandjaro, a volcano in eastern equatorial Africa, and of the rocks in its vicinity. Pegmatite, gneiss, amphibolite, basalt-obsidian, limburgite, nepheline- and feldspathic-basalts, tephrite, basanite, tufas, and other fragmental rocks are described. The basalt-obsidian was taken for andesite glass by Bonney,[3] whereas it really contains no augite—the mineral regarded as augite by Bonney being olivine. Among the limburgites three types are recognized. In one porphyritic olivine predominates over augite; in a second the olivine is subordinate to augite and hornblende; in the third hornblende is absent and augite is more abundant than olivine. The first and second kinds are closely allied to the feldspathic basalts, and the third to the nepheline-basalt. The olivine in these rocks contains a large number of inclusions of magnetite, augite, and spinel. It is zonally developed and is frequently surrounded by a rim of augite needles. The feldspathic basalts embrace hornblendic varieties, in which the hornblende is corroded and surrounded by an opacitic rim, composed of augite, magnetite, and olivine, and porphyritic varieties in which the large prophyritic crystals are anorthite. The nepheline-basanites are especially interesting because of the occurrence in them of anorthoclase so well developed that Hyland was enabled to determine its optical properties with great accuracy. This mineral is undoubtedly triclinic. Its extinction on the basal plane varies between 0° and $3\frac{1}{2}$°, and on the orthopinacoid between 5° and 6°. Its specific gravity is 2.63. Freed from impurities and analyzed it yielded :

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O
61.8	23.1	3.02	5.34	7.11	.09

A leucite basanite contains almost ideally developed leucite crystals—the first discovered in Africa.[4] The other rocks described in the paper present no features of especial interest.—An important contribution to the study of the younger nepheline rocks has recently been made by Stock,[5] of the University of Leipzig, who has thoroughly investigated the material composing the basalt hills near Löbau, Saxony. This material comprises nepheline- and

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Min. u. Petrog. Mitth., x., p. 203.
[3] Report Brit. Ass., 1885, p. 682.
[4] Cf. Amer. Naturalist, Nov., 1888, p. 1024.
[5] Min. u. Petrog. Mitth., ix., p. 429.

plagioclase-basalt, and nepheline-dolerite. The latter rock has been classed by Rosenbusch[1] among the nephelinites because of the supposed non-existence of olivine in it. The nepheline rocks have been erupted since the beginning of Tertiary time and are older than the plagioclase-basalt, which occurs in them in the form of dykes. The normal constituents of the nepheline rocks are augite, olivine, nepheline, apatite, biotite, and magnetite. The dolerite contains these as idiomorphic crystals in a groundmass composed of microlites of the same minerals and plagioclase in a devitrified base. In the finer grained variety the nepheline occurs principally as the interstitial substance between the other constituents. In both varieties this mineral possesses a tendency to pass into natrolite, phillipsite, and stilbite. The olivine is often so filled with magnetite that its true nature can be distinguished only with great difficulty. Twins of this mineral parallel to $P\breve{\infty}$ are not rare. Apatite is abundant, and frequently contains inclusions of the groundmass. Rubellan was discovered in a large number of sections, and hyalite and aragonite were found filling druse cavities. Both varieties of the nepheline rock are regarded as portions of the same magma. The dolerite is over the basalt, and is supposed to have cooled first. Inclusions of it are common in the underlying rock. Foreign inclusions, found also in this rock, consist of augite and sanidine, of which the former is usually on the exterior. Other common constituents of these inclusions are hematite, green spinel, and orange-colored rutile. The plagioclase-basalt contains quartz inclusions surrounded by rims of augite crystals.—Prof. Judd[2] calls attention to the fact that petrographical classification is based on the qualitative and not the quantitative determination of the constituents of rock masses. He shows that rocks composed of the same minerals may have widely varying compositions, even when their groundmass is approximately the same. Five examples of hypersthene andesites having the same mineralogical composition are taken, and it is shown that their content of silica ranges from 51.8% to 70%. The fact that the same minerals are found in rocks possessing such differences in composition is explained by supposing them to have crystallized in the earlier stages of the rock's solidification and then to have been separated from the residual magma, and finally to have recombined with this in proportions different from those in which they first occurred. Since the residual portion is much more acid than the individualized portion, it is easy to imagine rocks of any degree of acidity to have been formed by the mingling of the two portions in different amounts. The effect of the presence of water in lowering the fusing point of a rock is also discussed, in relation to its bearing on volcanic phenomena.

Mineralogical News.—*Note.*—In the mineralogical notes for the current year the crystallographic axes will always be repre-

[1] Mikroskopische Physiographie, ii., 1887, p. 791.
[2] Geol. Magazine, Jan., 1888, p. 1.

sented by the italicized small letters, *a, b, c,* and the axes of elasticity by the italicized capitals *A, B, C,* the latter indicating respectively the axes of greatest, mean, and least elasticity.—*New Minerals.*—*Sulphohalite* is a transparent, pale greenish-yellow mineral, crystallizing in the form of a dodecahedron, that was obtained from a drill-hole at the depth of thirty-five feet below the surface of the alkaline deposit at Borax Lake, California. It was associated with *hanksite,* and only one specimen was secured. The only two other specimens known to exist are in the collection of Mr. Bement, of Philadelphia. The mineral has been examined by Messrs. Hidden and Mackintosh.[1] Its specific gravity is 2.489, and its hardness 3.5. Its composition is represented by Na_2 ($\frac{3}{4}$ SO_4. $\frac{1}{4}$ Cl_2) or 3 Na_2SO_4 + 2 Na Cl, a formula analogous to that of the rare mineral *connellite,* which is thought to be a copper sulphato-chloride.—*Auerlite* is a new thorium mineral from the zircon mines in Henderson County, N. C. It is described by Messrs. Hidden and Mackintosh[2] as occurring in disintegrated granite and gneissic rocks, intimately associated with *zircon,* and frequently implanted upon this mineral in parallel position. The color of the new mineral on a fresh fracture varies between a lemon-yellow and a brownish-red. Its weathered exterior is of a dull yellowish-white. It has a waxy lustre, is subtranslucent to opaque, and is very brittle. Its hardness is 2.5–3, and its specific gravity 4.422–4.766. In crystallization it is tetragonal with the simple P and ∞ P faces. Its composition corresponding to $ThO_2 \left\{ \begin{matrix} SiO_2 \\ \frac{1}{3} P_2O_5 \end{matrix} \right\} H_2O$ is:

$H_2O.CO_2$	SiO_2	P_2O_5	ThO_2	Fe_2O_3	CaO	MgO	Al_2O_3
11.21	7.64	7.46	70.13	1.38	.49	.29	1.10

Auerlite thus appears to be a *thorite* in which part of the SiO_2 has been replaced by P_2O_5—the first recorded replacement of this kind in mineralogical literature.—Two new *sulphantimonites* are reported by Mr. Eakins[3] from Colorado. The first was found at the Domingo mine, Gunnison County, in aggregates of small acicular dull grayish-black crystals in the cavities of a gangue composed of siliceous material and calcite. Its analysis yielded:

Ag	Cu	Pb	Fe	Mn	Sb	S	Gangue
tr.	tr.	39.33	1.77	tr.	36.34	21.19	.52

corresponding to (Pb Fe)$_3$ Sb_4 S_9. The second is also found in little groups of crystals, of a bright steely-gray color. The individual crystals are larger than those of the first mineral, and occur together with pyrite and sphalerite in a siliceous gangue. Their composition is Pb_5 Sb_4 S_{11}, resembling *freieslebenite* in which the silver has been replaced by lead. Analysis gave:

[1] Am. Jour. Sci., Dec., 1888, p. 463.
[2] Ib., p. 461.
[3] Ib., p. 450.

Ag	Pb	Fe	Sb	S (calculated.)
tr.	55.52	tr.	25.99	18.98

General.—Scacchi[1] has published a complete catalogue of the minerals occurring at Mount Vesuvius. He divides them into (1) crystallized minerals occurring in pieces of foreign rock cast up during the eruptions of Monte Somma and the earlier eruptions of Vesuvius; (2) those forming lava bombs; (3) those occurring in the Monte Somma conglomerate, as a result of contact action; (4) those produced in the fumaroles by sublimation; (5) those formed in the lava during its cooling; and (6) those present on the walls of the amygdaloidal cavities in the lava. One hundred and twenty five mineral species are briefly described, and the name of the writer first mentioning them is given. The catalogue will prove of great convenience to collectors in the region and to those in charge of collections embracing many Vesuvian specimens.—Brezina[2] would add *tellurite* to the group comprising the oxides *claudetite* and *valentinite*. Crystals obtained from a porous sandstone at Facebaja were measured and found to be orthorhombic with $a : b : c = .4566 : 1 : .4693$. The predominant faces are $\infty \breve{P}\breve{\infty}$, $\infty \breve{P}_2$, $\infty \breve{P}_4$, ∞P and P, and the plane of the optical axes is $\infty \bar{P}\bar{\infty}$.—In the limestone near Bagnères de Bigorre, France, are little crystals of black *albite*, which, according to Lacroix,[3] have the following composition:

SiO_2	Al_2O_3	Na_2O	CaO	Ign	Specific gravity
67.04	20.45	10.57	.65	1.30	2.563

—Limur[4] describes a *staurolite* crystal from Moustoir-Ac, Morbihan, France, which consists of a core, composed of quartz and staurolite material, surrounded by two zones of staurolite, one with a granular structure, and the other with a fibrous structure, due to the arrangement of little needles perpendicular to the prismatic faces of the crystal.

New Books.—Rutley's "Rock-Forming Minerals."[5]—This little volume constitutes an excellent book for beginners in the study of microscopical geology. It includes an introduction to the methods made use of in the investigation of the optical and other physical properties of minerals, discusses the theory of polarized light, explains what is meant by "optical axes," "bisectrices," double refraction, etc., describes the polarizing microscope and other instruments used in the examination of minerals, and gives the principal characteristics of those minerals which enter into the composition of rocks. The explanations of the phenomena presented by sections of minerals when observed in polarized light, are given

[1] Neues Jahrb. f. Min., etc., 1888, ii., p. 123.
[2] Ref. N. J. B., 1888, i., p. 206.
[3] Bull. Soc. Franc. de Min., xi., p. 64.
[4] Ib., xi., p. 61.
[5] Rock-Forming Minerals. By Frank Rutley. With 126 ills. and 252 pp Thos. Murby, 3 Ludgate Circus Buildings, London, 1888.

with great clearness, with the aid of good figures, most of which are new. The second part, which deals with the properties of the individual minerals, is not as full as is Mr. Idding's translation of Rosenbusch's manual, but is entirely sufficient for all the purposes of students. Although a most excellent text-book for colleges, Mr. Rutley's work is hardly full enough in its special part for those who desire to make a specialty of petrography as an important aid in geological work. For those who wish merely to become acquainted with the methods of the science, there is no better book in any language.

"DAS MINERALREICH,"[1] the fifth volume of Lenze's Natural History Series, has been revised and brought up to date. In its present shape it is a handy little volume of five hundred and forty-four pages. It treats of the universal and special properties of minerals in a manner adapted to the wants of general readers and others, who are desirous of becoming acquainted with these substances. but who are unwilling to enter into their technical study. In the special part a large amount of space is devoted to those properties of the various minerals which make them suitable for economic use. As a consequence this portion of the book is much more interesting than the corresponding part in most text-books. In general style "Das Mineralreich" reminds one of Quenstedt's Mineralogie.

CROSBY'S "TABLES FOR THE DETERMINATION[2] OF COMMON MINERALS." has a great advantage over all other similar tables in common use, in that it deals only with those minerals with which the student is likely to meet in his every-day work. The determinative methods are based upon the physical properties rather than upon the blowpipe characteristics of the individual species. The tabulation is carefully done, and the little book will surely be welcome in those schools which are not provided with complete sets of blowpipe apparatus.

[1] Das Mineralreich. Bearbeitet von Dr. Otto Wünsche. V. Auf. Gotha, Thieanmanns Hofbuchhandlung, 1887. 544 pp., 16 Taf.
[2] Second Edition. By W. O. Crosby. Boston, 1888.

BOTANY.[1]

"FORTUITOUS VARIATIONS IN EUPATORIUM" is the title of a paper recently read by Lester F. Ward before the Biological Society of Washington. This was an interesting and suggestive talk without being a set paper, and led to many remarks by members present. Several definitions of life have been given, but Prof. Ward considered the best to be "a general tendency on the part of living matter to multiply itself, to increase its quantity." This increase may take place in all directions, and often does take place in more than one. If it is not in all directions it i because of obstacles in the way, and the real increase is in the direction of least resistance. Many variations are noticeable in both plant and animal world, that are apparently of no special advantage to the organism. These chance or fortuitous variations can scarcely have been produced by natural selection, inasmuch as there is no appreciable or even imaginable value in them to the plant or animal. There are, to be sure, many which are of advantage, and these are acted upon and improved through natural selection. Darwin has said, though with many reservations, that only advantageous variations are selected and preserved. This does not seem to be at all universally the case. Quantity not quality is the end for which nature strives, and this may be considered an almost universal law. Perfection in structure is a secondary consideration, while increase of quantity is of primary importance. Prof. Ward did not believe all variations were of use to plants. The general tendency to vary in every direction is often counterbalanced by a determined progress in one direction, and this is generally useful. The specimens of Eupatorium were so arranged as to show the variations in the leaves, these being more prominent than in the flowers. The leaves varied from finely dissected to linear, then to lanceolate and ovate. One hybrid with intermediate leaves was shown. There are about four hundred species in the genus, most of them South American, one Australian, and about thirty North American. The fact of great variation in the plants was undoubted. The fact of these being all beneficial is not proved. How a sharp or an obtuse point, a serrate or a crenate margin to a leaf would be of any benefit to a plant in any situation he could not see. Therefore it seemed to him that many of these variations should be considered fortuitous or chance variations due to the general tendency of all life to increase in all directions and so adding to the total quantity of life in the world.

Dr. Merriam rather dissented from the views of Prof. Ward, he believing the variations to be generally of some slight advantage,

[1] Edited by Charles E. Bessey, Lincoln, Neb.

though to us it may be inappreciable. Dr. Goode mentioned analogous variation in fishes, especially in the number of scales, the real usefulness of a greater or less number of these being unknown. Some families (as the Cyprinidæ) are remarkable for these variations, while others (*e.g.* Perches) are noted for few or no variations, the species being very distinct in all their characters. Prof. Riley fully agreed with Prof. Ward. His studies of insects showed the existence of many variations which were undoubtedly useful, but at the same time many others the purpose of which was not in the least apparent.—*Jos. F. James.*

Aster shortii.—Mr. E. S. Burgess has noted the occurrence of *Aster shortii* in the vicinity of Washington, D. C., a plant which had not been previously recorded. Prof. Ward in this connection mentioned he had found a species of *Lemna* new to the flora, and Dr. Vasey said he had found a species of *Festuca* not before known from the locality.—*Jos. F. James.*

"Causes of Configuration of Trees."—Prof. Fernow, Chief of Division of Forestry, read a paper upon this subject. He exhibited several photographs of trees growing upon the sides of hills. The trunks of these formed nearly a right angle with the slope, and the branches were parallel with the slope. It was suggested by Prof. Ward that possibly the photographs represented an abnormal mode of growth, and that they were due to unusual conditions. It was also suggested that the peculiar direction of growth of branches was due to the cropping of cattle. Few of those present had ever seen trees similar to these, and most were inclined to the opinion that they represented something abnormal.—*Jos. F. James.*

The Need of Making Measurements in Microscopical Work.—It is greatly to be desired that all workers with the microscope should make much more general use of the micrometer than is now the custom, particularly in botany. It is still a common thing to find descriptions of tissues accompanied by plates or figures with little to guide the reader as to the absolute size of the objects. In this the fathers sinned more than we, but we are by no means sinless, as may be seen by taking up almost any descriptive paper on botany. Cells, cell masses, filaments, hyphæ, spores of all kinds, pollen cells, etc., etc., should all be subjected to careful measurement. We may say that so many measurements are needless, but so the older botanists thought, greatly to our present discomfort.

In our botanical laboratories the student should be not only taught to make measurements of everything he studies, but the making of such measurements should be *a part of the study* of the object. No laboratory microscope should be used which does not have as one of its accessories always at hand an efficient micrometer.

Such a micrometer need not cost much. A simple disk of ruled glass dropped upon the diaphragm of the eye-piece will answer

every purpose in ordinary work. Or it may be a slip of glass which may be pushed through a slot in the eye-piece. Neither one ought to cost more than from one to two dollars, and ought to be afforded for every microscope in use in the laboratory.—*Charles E. Bessey.*

THE QUESTIONS OF NOMENCLATURE.—For some months a lively discussion has been going on in this country and England upon a few questions as to the proper interpretation of the laws relating to botanical nomenclature, the discussion in some cases broadening out so as to take in the inquiry as to the validity of certain laws, and the expediency of enacting new ones. "Shall we rigidly enforce the law of priority?" is the question which is causing the greatest disquiet just now. On the one hand we have those who urge its rigid enforcement, while on the other are those who say with Prof. Babington, "I think that we are going too far in enforcing the rule of priority in nomenclature as it is now attempted." (*Jour. Bot.*, Dec., 1888.)

Then there is the question as to the citation of the authority in case of a removal of a species from one genus to another. Shall we cite Linnæus still in case we remove one of his species into a genus which he may not even have known? If we do, we make him (say those of one party) say what he never said, while to cite as the authority the name of the author of the combination makes us lose sight of Linnæus as the originator of the specific name and the describer of the species. Upon this we merely inquire now whether we are to consider primarily the men who *have worked* in systematic botany, or the men who are working now and who will work after we are gone. Is all this matter of the citation of authorities for the purpose of "doing justice" to men, or for conducing to scientific accuracy? Do botanists think more of the "glory" of the individual, or the advancement of the science? We shall return to this erelong.—*Charles E. Bessey.*

BOTANY IN ST. LOUIS.—The recent reception of a volume of the Transactions of the Academy of Science of St. Louis (Vol. V., Nos. 1 and 2) reminds us of the work in botany which is being done in this Western city. Of the thirteen papers published, five are botanical, as follows: A Revision of the North American Linaceæ, by William Trelease; Description of *Lycoperdon missouriense,* by William Trelease; On the Pollination of *Phlomis tuberosa* L. and the Perforation of Flowers, by L. H. Pammel; Measurements of the Trimorphic Flowers of *Oxalis suksdorfii,* by W. G. Eliott. Jr.; Observations suggested by the preceding paper, by William Trelease.

In the first-mentioned paper twenty-one species of Linum are recognized as natives of North America. They are grouped under three tribes, viz.: (1) Eulinum, which includes *L. lewisii* Pursh (= *L. perenne* Auct). (2) Linastrum, including *L floridanum* Trelease (L. *virginianum,* var. *Floridanum* Planch). *L. virginianum* L., *L. striatum,* Walt., *L. neo-mexicanum* Greene, *L. kingii* Watson,

L. sulcatum Riddell, *L. rupestre* Engelm., *L. aristatum* Engelm., *L. rigidum* Pursh, and var. *puberulum* Engelm., *L. berlandieri* Hook., *L. multicaule* Hook. (3) Hesperolinon, including *L. digynum* Gray, *L. drymarioides* Curran, *L. adenophyllum* Gray, *L. breweri* Gray, *L. clevelandi* Greene, *L. micranthum* Gray, *L. spergulinum* Gray, *L. californicum* Benth., and var *L. confertum* Gray, *L. congestum* Gray. Two good plates illustrate the fruits, petals, and filaments.

The new Lycoperdon (*L. missouriense*) is 3 to 4 inches high and 2 to 4 inches in diameter, narrow below and enlarged and rounded above (*i.e.*, somewhat pear-shaped). Color of interior buff, spores globose, smooth, yellow 2½–3¾ μ in diameter. It grows in sod under trees.

Mr. Pammel's paper is a valuable one, but too long for a synopsis here, as are also the two remaining ones.

ARBOR DAY LITERATURE.—This annual tree planting day, which has spread from the place of its origin on the Nebraska plains eastward to many of the States, has given rise to a number of books, the latest of which is the neatly bound and printed volume, "Arbor Day," by R. W. Furnas. It makes no pretence to profundity, nor poetry, but gives in sketchy way the history of the tree planting movement in the West, with appeals for the growth of trees for beauty and for profit, and includes lists of those most valuable for various regions, with practical suggestions as to methods. The book is dedicated to and contains a fine portrait of the "author of Arbor Day." Mr. J. Sterling Morton, of Nebraska. It is a pretty and pleasant contribution to the literature of a part of botany too often neglected or ignored by botanists.

ANOTHER SCHOOL BOTANY.—Verily in botany "of making many books there is no end," and if one were obliged to study some of them he might well say with the wise man of old, "Much study is a weariness of the flesh." The last work to claim attention is one with the ambitious title of "Botany for Academies and Colleges, consisting of Plant Development and Structure from Seaweed to Clematis," by Annie Chambers-Ketchum, and brought out by the house of J. B. Lippincott Company, of Philadelphia.

The book is a book of definitions, and often not good ones at that. In the first paragraph we read that "Natural Science treats of all things in nature. Nature is a synonym for the Universe," and paragraph 5, "The plant is the vital link between the mineral and the animal. Plants feed on minerals and digest them into organic food." The style is sometimes rather lively, as, for example, in a note on zoospores (p. 7), "These little creatures are very social; they dance among themselves, circling merrily, but never jostling; no human dancers could be more polite; then when the heyday of youth is over, they withdraw their ciliæ (*sic*), produce an outer wall, send out root-like projections, and develop into staid mother plants"!!

In her attempt to make matters plain the author uses some odd terms, as "Virgin-parentage," "The Man's House," "The Woman's House," etc.

The second part of the book consists of a manual which is said to include "All the known orders with their representative genera." In this the Algæ constitute the first order, the Fungi the second, and the Lichens the third!

Without question the book cost the author a great deal of hard work, and it is a pity that it has been such a waste of energy.—*Charles E. Bessey.*

A VALUABLE BOOK FOR THE HERBARIUM.—Indispensable as Bentham and Hooker's *Genera Plantarum* is in the herbarium, it is often a troublesome book to handle on account of its great size. When one is obliged to search through the three volumes for some obscure genus the time taken is so much lost from work, and the wear and tear of the book itself from so much use is such as to threaten its early destruction. This is especially the case in those herbaria where advanced students have free access to the books and specimens.

The recently issued *Index Generum Phanerogamorum* by Th. Durand, of Brussels, is intended to take the place of the Genera Plantarum for much of the work in the herbarium. The orders and genera have the same sequence as in Bentham and Hooker's work. The mode of treatment may be made out from the following, taken from page 1:

ORDO I. RANUNCULACEÆ.

TRIBUS I. CLEMATIDEÆ.

1. **Clematis** L. G. I. 3 et 953.—Sp. descript. ultra 200, a cl. Kunze ad 66 reduct. Orbis. fere tot. reg. temp. et trop.
   Sect. 1. **Viticella** DC., Viticella Mörch.
   Sect. 2. **Cheiropsis** DC., Atragene L., Cheiropsis et Viorna Spach.
   Sect. 3. **Flammula** DC., Meclatic Spach.
2. **Naravelia** DC. G. I. 4.—Sp. 2 v. 3, Asia trop.

The first column of figures consists of a running enumeration of the genera which extends throughout the volume, the second column enumerates the genera of the orders merely.

In the prefatory conspectus the following table is given, showing the number of species (estimated) for the Phanerogams:

		Ordines.	Genera.	Species.
Dicotyledones	Polypetalæ	90	3,050	28,300
	Gamopetalæ	46	2,885	37,800
	Monochlamydeæ	36	849	12,100
		172	6,784	78,200
Monocotyledones		35	1,587	19,600
Gymnospermæ		3	46	2,420
Summa		210	8,417	100,220

The book is published in Berlin by the brothers Borntraeger, at about 20 marks.—*Charles E. Bessey.*

BACTERIOLOGY.[1]

A New Atlas of Bacteriology.—An important announcement is just received of a new photomicrographic "*Atlas der Bacterienkunde*," shortly to be issued by Doctors Fraenkel and Pfeiffer, of the University of Berlin. The names of the authors and their connection with Koch's laboratory make it probable that the undertaking will be of great service and will supply to working bacteriologists a convenient standard of reference. The plan which will be followed in issuing the "Atlas" is, to give "a systematic representation of the most important bacteriological objects." Accordingly, there will be given "first, the bacteria in general, in the various stages of their life history, and, then, in particular, the microörganisms of the principal infectious diseases of men and the lower animals."

The figures will be accompanied by an explanatory text; and extreme care is promised to secure unusual mechanical excellence. The "Atlas" will appear in from 12–15 parts, each containing about 10 photographs. The first is promised in January, 1889, and the others at intervals of about six weeks. The number of copies is to be limited, and the cost, per part, is to be 4 marks. The "Atlas" may be had of Hirschwald, in Berlin.

The Bacteriology of Natural and of Artificial Ice.—One of the latest numbers of the *Centralblatt für Bakteriologie* (IV., 22, 673) contains a summary of a recent paper by Heyroth, in which the latter gives the results of some three years of investigation of the purity of ice, and brings the subject, so far as it has been pursued by himself and others, up to 1888.

The usual "plate" cultures were employed, and the conclusions finally arrived at are:

1. Water on freezing into ice always excretes from itself, so to speak, a portion of its chemical and organic contents.

2. Certain organic substances are less affected than are inorganic salts.

3. Above all, the microörganisms, and among these not merely the ordinary harmless water bacteria, but also disease-producing forms, are able to withstand the process of freezing as it occurs in nature, and even a protracted exposure to the frozen condition, without loss of vegetative capacity or enfeeblement of their virulence.

The investigations of artificial ice did not make for it as favorable a showing—or, at least, not in all cases. It appears that the water

[1] This Department is edited by Prof. Wm. T. Sedgwick, of the Mass. Institute of Technology, Boston, Mass., to whom brief communications, books for review, etc., should be sent.

employed is not always as unobjectionable as ordinary drinking water, and also that the water employed is sometimes rendered more or less impure by the careless use of the process it undergoes. Accordingly, figures as high as 528, 960, 1323, and even 1610 bacteria per cc. were found, although, on the other hand, specimens were found which were absolutely sterile.

The following conclusions were reached, viz.:

1. That the ice used for preservative purposes and for the cooling of drinks ought, no matter how prepared, to be made of such water only as has already been found to be pure, and at least as good as that adapted for a public water supply.

2. For the sake of the continuous protection of its composition periodical and repeated examinations should be made of the ice supply and its sources.

Dissection of the Dog as a Basis for the Study of Physiology.—A handsome and conveniently arranged guide to so much of anatomy as may be learned from a fairly thorough dissection of the dog has been prepared by W. H. Howell, of Johns Hopkins University, and published by Henry Holt & Co., of New York. The work is avowedly done by a physiologist for physiological purposes; and in our opinion it has been done wisely and with discrimination. The worker who is endeavoring to get broad ideas of the position and relation of organs and parts as mechanisms, should never be buried under anatomical minutiæ to him of secondary importance, or confused beforehand by being told minutely what to do, or worse yet, what to see. By giving undue attention to his guide he is distracted from the objects before him, and sooner or later is in danger of losing both the interest and pleasure of discovery and, above all, the final reward of increased power and independence.

The book is not too large, possesses the great merits of simplicity and brevity, and ought to prove a real help to classes of a certain grade, in physiology.—*W. T. Sedgwick.*

ZOOLOGY.

The Anatomy of Protopterus.—Prof. W. N. Parker communicates to *Nature* (XXXIX., pp. 19–21) a preliminary note on the anatomy and physiology of *Protopterus annectans*, of which abundant material has recently been received at Freiburg. The whole epidermis is packed with goblet cells, and besides contains here and there multicellular glands like those of Amphibia. The normal epidermal cells are covered with a cuticular cap. The muscles of the

body serve as a food supply during the period of hibernation, their substance being carried away by leucocytes. The account of the nervous system is reserved for a later paper, but the fact is mentioned that the pulmonary nerves cross at the base of the lungs. A sympathetic system was not found. The body is well supplied with epidermal sense organs except on the paired fins. The author has no suggestion to make concerning the rich nerve supply of these latter organs. The olfactory organ partakes of the character of that in both Fishes and Amphibia, having the accessory cavities of the latter and the epithelium of the former. The eye has a large lens, the choroid is rudimentary and pigmentless, and iris and pupil are absent. No sense-cells were seen in sections of the tongue. A curious tube-like epithelial organ opens on the floor of the mouth in front of the tongue. Except the large liver no glands were connected with stomach or intestine, digestion being largely performed by the instrumentality of leucocytes. Parker cannot verify Ayres' supposition that the lymphatics connect directly with the lumen of the stomach. The so-called urinary bladder is a cloacal cæcum, having much the position of the rectal gland of Elasmobranchs, and probably has no homology with the urinary bladder of other forms. The corpuscles of the blood are large, and the white are very abundant. The red corpuscles are oval and measure from .040 to .046 mm. in length and from .025 to .027 mm. in breadth. Of the white corpuscles two kinds may be distinguished: (1) large leucocytes of the ordinary form, and (2) leucocytes of various sizes, which, besides the ordinary pseudopodia, form stiff filamentous processes. Experiments render it probable that the latter convey nutriment from the alimentary canal to the blood and there disintegrate. Hyrtl's description of the circulatory apparatus of Lepidosiren would answer almost equally well for Protopterus There are no nephrostomes in connection with the kidneys. In a male with immature spermatozoa the anterior parts of the Müllerian ducts were present, each with an abdominal opening like that of the oviduct. In sexually mature individuals all traces of the Müllerian ducts disappear. The spermatozoa are carrot-shaped and are provided with two long cilia. The head of the spermatozoan was about .04 mm. in length.

Another Specimen of Hyla Andersonii.—On June 1, 1888, I found a single specimen of *Hyla andersonii* Baird in a wet place on the border of a pine barren, at May's Landing, N. J. It was quite lively when caught, but it soon became sluggish in confinement. Its voice was shrill and light, comparatively speaking; and it consisted of a repetition of the same note three or four times in regular succession, in a sort of "peep, peep, peep, peep," as nearly as I can give it. The specimen was sent alive to Dr. C. C. Abbott, of Trenton, N. J., who says, in his "Catalogue of the Vertebrate Animals of New Jersey" (*Geology of N. J.*, Cook, 1868, p. 805) that it is "a Southern species, a single specimen of which was found in Camden Co. in 1863" by Dr. J. Leidy.

Jordan's "Manual of the Vertebrates," 5th ed., says "N. J. to S. C. rare," which statement is still further confirmed by my discovery as given above.

The specimen is still alive, and may be seen by applying to George Pine, Esq., Trenton, N. J.—*John E. Peters, Sc. Doc., May's Landing, N. J.*

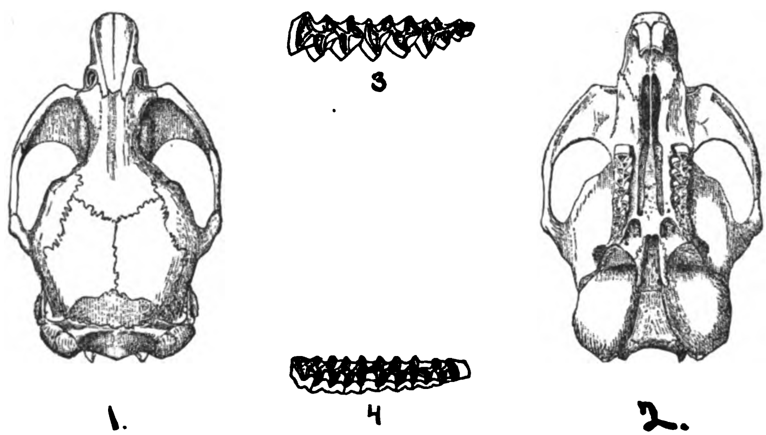
A NEW SPERMOPHILUS.—Dr. Merriam has recently described a new species of ground-squirrel from the Sierra Nevadas of California. He calls it *Spermophilus beldingi*. The characters are taken from the coloration and from certain peculiar features of the skull. A broad band of rufous brown runs down the back of the new species, while in the one nearest allied to it the whole back is covered with small spots, giving it a peculiar maculated appearance. The difference in coloration of the two is not due to seasonal changes, as suites of the two species were collected at the same period of the year.—*Jos. F. James.*

THE DEER OF CENTRAL AMERICA have been recently investigated by Mr. F. W. True. All the species are small, even the Virginia deer, which extends that far south. The Mexican deer seems to pass into the Virginian form. All the species are very much mixed up, and few characters seem to be constant enough to certainly characterize the species. The antlers. which have been largely depended upon, he did not consider reliable. A new species was described from the material in the National Museum.—*Jos. F. James.*

AN INTERESTING MAMMAL.—In the last number of the AMERICAN NATURALIST was noticed the discovery of a new Australian mammal. The *Zoologischer Anzeiger* for November 19, 1888, contains a short account by A. Zietz. from which we condense the following additional details. In form and size it resembles Chrysochloris. has a thick, short. fine whitish-yellow pelt. a small head with rounded snout, which is covered above by two horny plates, one behind the other. The skin is not perforated for the eyes, and the eyes themselves are only two black-pigmented points. The ear openings are covered by the fur; the nostrils lateral and slit-like. The salivary glands are very large. The fore feet are short, stout, and directed outwards, and the hands are folded longitudinally, bringing the fingers into two series, one of which is composed of the short digit 1 and digits 2 and 3 with long pointed nails. The other (outer) series consists of the 4th digit, with a small elongate, and digit 5, with a large triangular shield-like nail. The soles of the hinder feet are directed outwards; the toes, which are connected by skin, are armed with broad claws. The long, strong tail is hairless, but has strong transverse ridges and ends in a button. On the belly there is a well-marked pouch, 3 mm. long and 2 mm. (? cm.) wide. No external genital openings were seen. The dentition is

very peculiar and appears related to that of Amphitherium of the English Oölite. A clavicle is present. Only a single specimen is known, and that lacks the viscera and is partially decayed. It was found in the sandy region 500 miles north of Adelaide and 150 west from Charlotte Waters. The natives were questioned about it, and only one old woman could recall having seen one before. It appears to be a burrowing animal, and a portion of the alimentary tract which was preserved was filled with the remains of ants. It also appears to be a monotreme, and if the dentition can be relied upon, it forms an interesting remnant of the ancient fauna, and is to-day the oldest living mammal.

A Correction: Arvicola (Chilotus) pallidus.—The August number of the American Naturalist contains a description of the above-named species (Vol. XXII., 1888, pp. 702–705). Through a most unfortunate blunder, the illustration accompanying this description (p. 704), instead of being the drawing sent with the manuscript, is a figure of *Arvicola (Pedomys) minor,* which was published with a description of that species in the preceding number of



No. 4431. Female *Arvicola (Chilotus) pallidus* Merriam. From Ft. Buford, Dakota (Type) 1 and 2, skull, double natural size; 3, upper molar series, × 5; 4, lower molar series, × 5.

the Naturalist (July, 1888, p. 599), the same cut being made to illustrate two very distinct subgenera! The accompanying figure is that of *Arvicola (Chilotus) pallidus,* and should be substituted for that on p. 704 of the August number. In the lettering under the skull of *Arvicola (Pedomys) minor,* p. 599, the skull number is given as 2245. It should be 2224. C. Hart Merriam.

Zoological News.—General.—Prof. J. B. Steere says (*Nature,* XXXIX., p. 37) that the Philippine Islands are readily divisible into several distinct sub-provinces clearly distinguishable by their faunæ.

These are (1) Northern Philippines, consisting of Luzon and Murinduque and a few small islands around Luzon; (2) Mindoro; (3) Central Philippines, embracing Panay, Negros, Guimaras, Zebu, Bohol, and Masbate; (4) Eastern Philippines, comprising Samar and Leyte; (5) Southern Philippines, made up of Mindanao, Basilau, and perhaps Sulu; and (6) Western Philippines, consisting of Palawan and Balabac.

ECHINODERMS.—Prof. P. Herbert Carpenter is studying the Comatulæ of the "Blake" explorations in the Caribbean Sea.

WORMS.—F. E. Beddard (*Nature*, XXXIX., p. 15) describes some very large hooked bristles upon the caudal end of an earthworm (? Urochæta) received from Bermuda which he suggests are correlated with the habit which most earthworms have of lying with the anterior part of the body out of the ground, only the tail being kept within the hole. These bristles would thus form very efficient anchors.

FISHES.—At a meeting of the Biological Society of Washington, Dec. 1, 1888, Dr. Gill made some remarks on the Psychrolutidæ, a small family of fishes established by Dr. Günther on a specimen found in the Gulf of Georgia. Later, another species found in New Zealand was referred to the same family, and a third was recorded from Patagonia. There seems little reason for making a new family for these three species. They probably belong to a section of the Cottidæ. The occurrence of species in New Zealand and in South America is interesting, inasmuch as it shows representatives of the Cottidæ exist in the Southern as well as in the Northern hemisphere.—*Jos. F. James.*

ENTOMOLOGY.[1]

ON PREVENTING THE RAVAGES OF WIRE-WORMS.—In a recently published paper,[2] the editor of this department makes a preliminary report on an investigation of wire-worms, now in progress. In the course of this investigation a method of combating these pests has been devised which promises to be of considerable importance.

At the beginning of our study of wire-worms, experiments were tried to ascertain if it were practicable to protect the seed and young

[1] This Department is edited by Prof J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Bull. Cornell Univ. Agr'l Exp. Station, iii., pp. 31–39.

plants in a corn-field by furnishing the worms with other food. Baits of sliced potatoes, clover, corn-meal dough, and corn-meal dough sweetened with sugar, were placed in various positions in a badly infested field. This was soon after the field had been planted and before the corn came up. In most cases the baits were placed on the surface of the ground and covered with small boards. Boards were used instead of earth for covering the baits to facilitate the examination of them. It now seems probable that more worms would have been attracted had the baits been buried.

The results of our efforts to trap wire-worms were very different from what we had expected. A few were taken in traps baited with sweetened dough, not enough, however, to be of much practical importance. But to our surprise, large numbers of click-beetles were taken. This at once opened a new line of investigation. If it is possible to trap and destroy the beetles before they have laid their eggs, we have at our command a much more effectual method of preventing the ravages of wire-worms than by destroying the larvæ after they are partially grown.

As indicating the possible efficiency of this method, I will cite a single instance. A series of twelve traps, which had been left undisturbed for only three days, yielded 482 beetles, or an average of more than 40 beetles per trap. And this notwithstanding that a considerable number had been attracted to other traps in the immediate vicinity.[1]

Of the substances used as baits clover attracted by far the larger number of beetles. The clover baits were small bunches about one-quarter pound in weight, of freshly cut stalks and leaves. Next to clover in the order of efficiency was sweetened dough. This was made by mixing one part sugar with ten parts corn-meal and sufficient water to make a dough. About one-half a teacupful was used in each trap. Unsweetened dough and sliced potatoes proved to be of nearly equal value, but much less attractive than sweetened dough.

We thus demonstrated that it is an easy matter to trap click-beetles in the places where they abound—that they will collect in large numbers upon baits of clover or of sweetened corn-meal dough. The collection of the beetles, however, from such baits involves considerable labor. We therefore conducted experiments to ascertain if this labor could be saved, and obtained the following results:

Many beetles were collected from our traps and placed in breeding cages. Some of these cages were supplied with clover, others with sliced potatoes, others with dough, and still others with sweetened dough. In one series of cages these substances were poisoned. In another, used as a check, the food was not poisoned. At the same time an extensive series of traps were placed in the corn-field. In this case alternate traps were poisoned, the others not.

[1] More than one-half of the click-beetles collected in these experiments were *Agriotes mancus*. Next in abundance was *Drasterius dorsalis*. A few specimens of *Agriotes pubescens* were also taken.

As was to be expected, no dead beetles were found in the traps that were not poisoned; nor did the beetles die soon in those cages supplied with unpoisoned food. But where the clover or dough was poisoned the beetles in most cases were destroyed, proving that they feed upon these substances, and suggesting a practical method of combating them.

Although these experiments were conducted in a field from which a large number of the beetles had been removed, twelve examinations of the traps baited as described above yielded an average of 23½ dead beetles per trap. In some cases twice that number were found at one time in a single trap.

When we take into consideration the small amount of labor involved in distributing poisoned baits as described, and in renewing them once or twice per week during the early part of the summer, and consider also the large number of beetles that can be destroyed, many of them doubtless before they have laid their eggs, we feel warranted in earnestly recommending that these important pests be fought in this way.—*J. H. Comstock.*

NOTE ON CHINCH BUG DISEASES.—Two diseases of *Blissus leucopterus,* apparently efficient in suppressing an outbreak of this species in 1882, were described by me in my report for that year as State Entomologist of Illinois (pp. 47–54); but neither of these has been distinctly recognized since, until the present season. Now, however, the chinch bugs of the southern part of Illinois are being very rapidly destroyed by both these diseases, and a third not hitherto recognized—the last (seen by me first in July, 1887) due to a Botrytis distinct from the species (*B. bassiana*) well known as the characteristic fungus of muscardine in the silkworm.

One of the two first mentioned is caused by an Entomophthora whose specific affinities I have not been able to learn.

The other is due to a microbe (the *Micrococcus insectorum* of Burrill [1]) principally developed in the alimentary canal, and especially in its cæcal appendages, which are often literally crammed with it from end to end. This disease somewhat resembles that known as *schlaffsucht* or *flacherie* in the literature of the silkworm. Its germ is freely cultivable both in beef broth and in solid gelatine media, by the processes usual in bacterial investigation.

Both the Entomophthora and the Botrytis finally imbed the insect in a white fungus—the efflorescence of a spore-bearing mycelium. The Bo rytis has been much more abundant and destructive in Illinois than the Entomophthora, although seemingly less so at present than the bacterial form.

It now seems likely that these diseases, occurring as they do

[1] American Naturalist, xvii., p. 319. This microbe, studied anew by Prof. Burrill from my recent cultures, solid and fluid, and from the affected chinch bugs themselves, proves to be a Bacillus of peculiar character, and not a Micrococcus.

spontaneously over a large area, will soon suppress what has probably been the longest continued destructive outbreak of the chinch bug known in the history of that insect. Their present activity is illustrated by the fact that in a single field in Southern Illinois dead chinch bugs imbedded in this mould were found by an assistant, Mr. John Marten, so numerous as to suggest a recent flurry of snow.—*S. A. Forbes* (in *Psyche*, Oct., 1888).

POISON OF HYMENOPTERA.—One of the most interesting phénomena met by the student of the habits of insects, and one that has long excited wonder, is the fact that the Digger-wasps or Fossorial Hymenóptera sting the insects with which they provision their nests in such a way that the insects are paralyzed, but not killed.

It has been commonly believed that the Digger-wasps could easily destroy their victims if they chose to do so; but instead of doing so they sting them "just enough to paralyze them but not enough to kill them;" for they know instinctively that on the one hand dead insects would not be suitable food for their young, and on the other, that if the insects with which the nest is provisioned are left uninjured, the larva which hatches from the egg placed with them would be unable to overpower them.

Some have held that the paralyzing of the prey is accomplished by making a slight sting in one of the ganglia of the ventral nervous system. This, however, implies an instinctively obtained knowledge of insect anatomy which is to say the least remarkable.

A very different explanation of the phenomenon is now offered by M. G. Carlet.[1] In an earlier note[2] he showed that the wound inflicted by the Hymenoptera with a barbed sting (Bees and true Wasps) always resulted in a mixture of two liquids; one, an acid, the other, an alkali, each secreted by a special gland. And he also showed that the venom produced the usual results only when it contained these two constituents. He has now studied the poison of Hynenoptera with a smooth sting (Philanthus, Pompilus, etc.), and finds that with these the alkaline gland either does not exist or is rudimentary. These are the Hymenoptera whose incomplete poison does not kill the insects with which they provision their nests, for the purpose of feeding their larvæ with living prey. In M. Carlet's opinion it is the presence of the two liquids or of one only which produces respectively the mortal poison or the anæsthetic, and not the asserted power to select the point of the body at which the Digger-wasp will sting its victim.

REPORT OF THE STATE ENTOMOLOGIST OF NEW YORK.—Dr. Lintner's Fourth Report has just appeared. It makes a volume of 237 pages, and includes accounts of a large number of insects, some of which are described here for the first time. This report, like those that have preceded it, is the result of a great amount of pains-

[1] Comptes Rendus, cvi. (1888), pp. 1737–40.
[2] Ib., seance du 23 juin 1884.

taking labor, and is a valuable addition to the literature of Economic Entomology. The number of subjects described is so large that it is impracticable to give an abstract of the report.

THALESSA AND TREMEX.—A paper was recently read by Prof. Riley, entitled "Notes on the Economy of *Thalessa* and *Tremex*." *Thalessa* is an Ichneumon fly having in some species an ovipositor six and seven inches in length. The eggs are laid in the burrow of the larva of *Tremex* and not in the larva itself, so it is an external and not an internal parasite of the larva. The ovipositor performs the part of a saw and drills a hole in the bark over the burrow of *Tremex*. Owing to the great length of the ovipositor, it was long a question how the insect could reach the bark to deposit its eggs. It is accomplished by the insect so manipulating the organ with its feet as to form a double coil in a special membrane between the last two segments of the abdomen, then curving it over and passing it downward so as to reach the wood. In the pupa this ovipositor is bent round and along the ventral surface and then backwards again along the dorsal surface.

A "HUMAN PARASITE."—Prof. Riley mentions in a general way the occurrence of parasites upon or in the human body. He mentioned particularly the case of a lady in Washington who felt herself stung by some insect. In the course of a few weeks she was annoyed by a pimple on her neck. When pressed, there was forced from the spot a small larva, of some species of bot-fly, but as nothing was known of its parent, its identification was impossible. Reference was also made to another parasite noticed by a physician of New Orleans, an account of which had been given in a late mumber of "Insect Life." —*Jos. F. James.*

EMBRYOLOGY.[1]

THE BYSSUS OF THE YOUNG OF THE COMMON CLAM (*Mya arenaria* L.).—During the past summer Mr. Vinal N. Edwards, the well-known collector of the U. S. Fish Commission, at Woods Holl, found young clams adhering in great numbers to the surface of floating timbers in the harbor of New Bedford, Mass. They were associated with Ascidians (*Molgula*) in this unusual position, and very naturally attracted the attention of so observant a field-naturalist as Mr. Edwards, who very kindly brought me an abundant supply of specimens. The masses as they came into my hand were in flakes formed of marine algæ and earthy matters, sand, and mould, which

[1] This Department is edited by Prof. John A. Ryder, University of Pennsylvania, Philadelphia.

had been peeled off of the surface of the floating timbers. These masses were traversed superficially by a mat of fibres which were found to be derived from the outer tunic or mantle of the Ascidians, by means of which the latter were adherent to their support.

At first, in separating the young clams from their singular place of support, it was supposed that their rather firm adhesion was altogether due to their having been caught during the very early veliger stage in this mat of fibres formed about the bases of the Ascidians. As they grew larger it was further supposed that they were held fast in their unusual position by the fibres and cement substance secreted by the mantles of their Ascidian neighbors, and thus were suffered to attain a considerable size (from two to fifteen millimetres) before they finally became free and sank into a more favorable position on the bottom. However, further investigation showed that in this I was in error, for after a careful search, a few individuals were found from which a single byssal thread was found to proceed, invariably from the point where the tip of the foot is thrust through the median opening in the mantle. To make it still more certain that there should be no mistake, the byssal thread was pulled out of its insertion in several specimens, when it was found to present the irregular swollen proximal end usually found to characterize the intraglandular portion of the byssus in molluscs which possess this organ. The subject at this point became sufficiently interesting to warrant farther study, and, inasmuch as but a few individuals were found which had the byssal thread in place, that structure being usually torn loose in removing the specimens from their support amongst the Ascidians, it became necessary to resort to the methods of sectioning to determine if there was a byssal gland present in the foot.

To this end a number of specimens were treated first with a dilute chromic acid solution (one-half per cent.). After this had fixed the tissues, the solution was renewed and acidulated with nitric acid (one-half per cent.), and allowed to act until all of the calcareous matter had been removed from the shell. This left the specimens in good histological condition for cutting, after which the specimens were washed, dehydrated, and saturated with celloidin, in which they were embedded and sectioned on a Schanze microtome.

The sections were cut parallel to the median longitudinal plane, or so as to coincide with the union of the edges of the mantle along the margins of the valves. Besides disclosing the unmistakable anatomical structure characteristic of *Mya*, there was found in the sections of the median region at the apex of the foot a median saccular depression which was undoubtedly the byssal gland with the thread in place or with remains of the secretion from which the byssal thread was formed.

This discovery leaves no doubt as to the fact that this well-known mollusc is provided with a byssus during its early life. One series of sections in my possession, from a specimen ten millimetres long, shows the structure admirably. How much longer than usual

the young clams were kept suspended in this instance on account of their accidental and supplementary adhesion to the Ascidians cannot be determined, but it is fair to suppose that their period of suspension would be prolonged on that account beyond the usual time.

The presence of a byssal attachment in *Mya arenaria* reopens the question of the life-history of this important shell-fish. In fact, it is probable that some of its allies may have an unknown byssal stage, and, perhaps, types somewhat distant from it in the system, but with similar habits in the adult condition, such as *Glycimeris* and *Panopæa,* may also have such a stage. In that case the methods hitherto proposed to be adopted in order to secure the young for purposes of transplanting would have to be greatly modified. It is very probable that this arrangement is a protective one and that the suspension of the young of *Mya arenaria* is for the purpose of protection during the early and most precarious period of existence of the animal. To obtain the early stages of the young ti will accordingly be necessary to resort to some form of "collector" or cultch, such as is used in oyster-culture, to allow the fry to affix itself.

While there is a very sharply defined homogeneous larval shell or protoconch in the young oyster, this seems to be absent or not sharply defined in the young of *Mya arenaria* in specimens two to three millimeters long. In *Chlamydoconcha* the protoconch or larval shell is preserved even in individuals supposed to be adult, since here both valves are completely invested by the closed mantle sac, the shell being internal. The detection of a byssus in the young of *Mya* is of interest also from the fact that it suggests that such organs are probably present in the young stages of still other Lamellibranchs, where it has not been hitherto suspected.—*John A. Ryder.*

PHYSIOLOGY.[1]

On the Rhythm of the Mammalian Heart.—Prof. John A. McWilliam,[2] of the University of Aberdeen, extends to a study of the mammalian heart the methods of work which in the hands of Gaskell, Mills, himself, and others have led recently to such valuable results concerning the organ in Fishes, Amphibians, and Reptiles. He experiments with cats, dogs, rabbits, hedgehogs, guinea-pigs, and rats, partly on the excised heart and partly on the heart *in situ,* and obtains many interesting data, which he compares with the known facts in the cold-blooded animals. As in the latter, so in

[1] This Department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.
[2] The Journal of Physiology, Vol. 9, p. 167.

mammals the contractions of the heart muscle are always maximal, and a rhythmic rise and fall occur in the muscular excitability—a fall immediately succeeding the contraction, followed by a gradual rise during the phase of relaxation; hence the more rapid the beat, the less powerful it is, and *vice versa.* Constant currents and weak induction currents are alike in causing an acceleration of beat in an already active heart, and the appearance of a rhythmic series of beats in one previously quiescent. As in all other Vertebrates, the mammalian heart-beat partakes of the nature of a progressive contraction beginning at the venous end of the organ. The place of origin of the contraction seems to be the walls of the great veins, and the time of origin is the same for the venæ cavæ and the pulmonary veins. Whether the mammalian cardiac rhythm is nervous or myogonic—*i.e.*, whether it is a property of nervous or muscular tissue—is impossible at present to decide. That heart muscle has a spontaneous rhythmic power of its own is abundantly proved for Fishes, Amphibians, and Reptiles, although it seems that normally, in the auricular muscle at least, such power is in abeyance. The following facts concerning the mammalian heart muscle will help in the future to elucidate this subject. All parts of the heart are endowed with independent rhythmic power, as is proved by the continuance of rhythmic contractions in parts separated from each other—*e.g.*, in ventricles separated from auricles; the independent ventricular rhythm seems at times to be myogonic, for by increasing the local excitability, as by the local application of heat, the contraction may be made to begin in the apex, where, according to the researches of the author and those of Kasem Beck, nerve-cells do not occur; the automatic rhythmic property is not equal in the various parts of the heart, being apparently highest in the venous terminations, and lowest in the ventricle, as indicated, among other things, by the slow rhythm in the isolated ventricle (which is in harmony with what exists in the lower Vertebrates); the rhythm originating at the venous terminations apparently dominates the whole heart, and determines the rate of its action; hence the causes determining the rhythm of the intact heart are to be sought for at the venous end of the organ. The usual order of contraction may be altered and even entirely reversed by artificially stimulating a portion of the surface—*e.g.*, stimulation of the ventricle is followed by contraction of the ventricle, then auricle, then venous terminations.

The question of the mode of propagation of the normal contraction over the auricles and ventricles is discussed by the author at some length, in view of the fact that Gaskell has urged that in the tortoise the phenomenon is simply one of muscular conduction. Such an explanation is negatived at once for the mammalian heart, as regards the passage from auricle to ventricle at least, by the fact that here is a distinct break in the muscular continuity, the auricles and ventricles being separated by a considerable amount of connective tissue. It seems impossible to account for the sequence on

purely physical grounds, such as the distension of the ventricular cavities, the electric variation accompanying the auricular beat, or the sudden tension of the chordæ tendineæ resulting from the contraction of the auricular muscle fibres which go down into the auriculo-ventricular valves. The author is hence forced to a belief in the existence of a nervous mechanism for the propagation. What this mechanism is, is not known, but it is possible that an extensive nerve plexus exists throughout the whole of the cardiac wall. Passage of the contraction through the substance of the auricle is independent of the great nerve-trunks, since these may be destroyed and the wall even cut into zigzag strips without interfering with the action.

CONNECTIONS OF MEMBRANOUS LABYRINTH.—In Fishes, Amphibians, and Reptiles the *ductus endolymphaticus* of the inner ear has long been known not to constitute a closed cavity, but to join the exterior (Elasmobranchs) or the lymph-spaces of the cranial cavity. Rüdinger[1] finds an analogous arrangement to exist in mammals and man. The ductus does not here end blindly, as has hitherto been supposed, but by means of several branched canals is in communication with the subdural lymph-spaces of the dura mater. These canals are probably homologous with those of the lower vertebrates. The author regards the ductus as an elastic bag, the function of which is to enable the differences of pressure occurring within the labyrinth to be readily balanced. The size, the bladder-like form, and the situation of the ductus in the cranial cavity, instead of within the bony labyrinth, favor such a theory.

FUNCTION OF THE COCHLEA.—The most commonly accepted hypothesis regarding the mode of analysis of composite sounds by the cochlea is that of Hensen, according to which a small portion of the basilar membrane is put into vibration by the incoming waves; deep tones affect the membrane where it is widest—*i.e.*, at the apex of the cochlea; high tones affect the narrow portion at the cochlear base. This theory is supported by an observation of Munk that a dog, in whom the base of the cochlea had been injured, could hear low tones only. Stepanow[2] has recently tested the theory experimentally by destroying the apex of the cochlea in the guinea-pig, in which animal the cochlea projects freely into the auditory bulla. Different instruments, comprising the violin, piano, harmonica, Galton's whistle, B-bass, tuning-fork, etc., were employed to test the power of hearing; and the perception of sound was inferred from the reflex movement of the ears. In spite of destruction of a considerable portion of the apical region of the cochlea, accompanied by loss of endolymph, the animals reacted to all tones, and, what is especially

[1] Sitzungsber. d. math.-phys., Cl. d. k. bayer., Akad. d. Wiss., 1887. Heft. 3, p. 455. Cf. Münchener Med. Wochenschr., 1888, p. 139.

[2] Monatschr. f. Ohrenh., xxii., p. 85. Cf. Centralblatt f. Physiologie, 1888, p. 298.

important, perception of the deep tones did not seem to be wanting. The author regards Hensen's hypothesis as not proved, and inclines to the theory of Voltolini that each nerve fibre of the cochlea recognizes all tones.

A Recent Study of "Rigor Mortis."—Some important work on rigor mortis has lately been done in the Physiological Institute at Königsberg by Max Bierfreund, cand. med.[1] Since the time of Nysten (1811) physiologists generally have suspected that the nervous system has some appreciable influence upon the time of appearance of rigor, and possibly upon its subsequent intensity. Munk, Bleuler and Lehmann, v. Eiselsberg, Tamassia, and others have investigated the question and have come to quite contradictory conclusions. Tamassia asserts that rigor is completely independent of the nervous system, and supports this theory by the results of a number of experiments on frogs, sparrows, and guinea-pigs. A. v. Gendre, v. Eiselsberg, and now Max Bierfreund have, on the other hand, arrived at the opposite conclusion. Bierfreund has found in all the experiments performed by him decided evidence that some influence proceeds from the nervous system. When he cut the sciatic nerve of a freshly-killed animal he found that rigor mortis always set in on that side 10–20 minutes later than in the muscles of the uninjured leg. This indicates that the nervous system exercises a quickening influence upon rigor, and this view is fully borne out by experiments upon the central nervous mechanism. Division of the lateral columns of the spinal cord or extirpation of one of the cerebral hemispheres will cause a delay in the appearance of rigor on the side which is dependent on the part removed. Bierfreund found, also, as might have been anticipated, that destruction of the central organs diminished the intensity of the rigor.

The red muscles stiffen much later than the white (11–15 hrs. as against 1–3 hrs.); and the time taken for completion of the rigor in the red muscles is much longer (52–58 hrs. as against 10–14 hrs.). Bierfreund sees in this fact an explanation of the so-called law of Nysten that the muscles of the body fall into rigor in a fixed and definite order. He observed, for example, that in rabbits the muscles of the hind limbs, where white muscles predominate, invariably stiffen sooner than those of the fore limbs, where the muscles are exclusively red.

High temperatures hasten the onset and the subsequent disappearance of rigor. Narcotics (chloroform and ether) if inhaled, delay it, but, if injected into the blood, produce a condition similar to rigor by their direct effect on the muscle substance. Chloral, which has no direct influence upon the muscle, effects a retardation of rigor when injected into the blood. Curare, according to von Eiselsberg and von Gendre, appears to destroy completely the influ-

[1] Untersuchungen über die Todtenstarre, Pflüger's Archiv, Bd. XLIII., S. 195.

ence of the nervous system. Stimulation of the sciatic on one side with a subminimal electric current causes rigor to appear later on that side.

The disappearance of rigor is not due to the fact that putrefaction liquefies a coagulated proteid. Putrefaction and rigor do not run parallel courses; frogs are occasionally found in a state of rigor in spite of intense putrefaction. If putrefaction be checked by injection of carbolic acid or corrosive sublimate into the blood-vessels of the animal the rigor disappears just as quickly as in an animal in which putrefaction is given full sway.

Bierfreund regards as highly significant the fact that rigor vanishes of itself and independently of the putrefaction. He looks upon rigor mortis as the last contraction of the muscle, the last act in the life-history of the muscle fibre; but by what stimulus or stimuli this contraction is called forth, he leaves us still uncertain. —*E. D. Jordan, Boston.*

THE MECHANICAL ORIGIN OF THE HARD PARTS OF THE MAMMALIA.—A paper on this subject was read by the writer before the American Philosophical Society, Jan. 3.

Summarizing the investigation, the author stated that the structures of the mammalian skeleton and dentition may be referred broadly to the two general classes, excess of growth and defect of growth. Each of these may be again divided into two series as follows:

Excess of growth $\left\{\begin{array}{l}\text{Use.}\\\text{Luxuriance.}\end{array}\right.$

Defect of growth $\left\{\begin{array}{l}\text{Disuse.}\\\text{Poverty.}\end{array}\right.$

The paper dwelt principally with the first two conditions, which have frequently co-operated in the development of structures. These were classified under the following mechanical energies as causes:

A. Motion in articulation.

1. Impact only.
   - Facetting of distal end of radius in Diplarthra.
   - Expansion of proximal end of radius in Diplarthra,
   - Grooving of distal end of tibia by astragalus.
   - Grooving of proximal end of astragalus by tibia.
   - External trochlea of humerus in Rodentia (Leporidæ), and metapodials and humerus in Diplarthra.
2. Torsion only.
   - Alternation of carpal bones in Anthropomorpha.
   - Symmetrical flanges of ulnar cotylus in Anthropomorpha.
   - Unsymmetrical flanges of ulnar cotylus in other mammalia.
   - Rounding of head of radius in Edentata and Quadrumana.
   - Involution of eygapophyses in Diplarthra, etc.
3. Torsion and impact without flexure.
   - Alternation of carpal and torsal bones in Ungulata.

4. Torsion, impact, and flexure in one plane.
   Tongue and groove joints in many orders.
5. Flexure in two planes.
   Saddle-shaped cervical vertebræ in Quadrumana.
6. Flexure in several directions.
   Ball and socket vertebral articulation.
   Heads of humerus and femur.

AA. Motion not in articulation. (Teeth.)

7. Displacement of cusps of triconodont molars by crowding.
   Tritubercular molars.
8. Transverse thrust.
   The Vs of molars teeth in various orders.
9. Longitudinal thrust.
   The Vs of the Multituberculata.
   Obliquity of molars in many Rodentia.
10. Stimulation of pressure and strain.
    Incisors of Rodentia, Multituberculata, etc.
    Prismatic molars of Diplarthra, Rodentia, etc.
    Confluence of cusps into crests generally.
    Sectorial teeth of Carnivora.
    Canine teeth in general.
    Incisors of Proboscidia, Monodon, Halicore, etc.

As a general result we may assert that that it is a general law of animal as of other mechanics—viz., that *identical causes produce identical results.* The evidence for this law may be arranged under two heads, as follows:

I. The same structure appears in distinct phyla which are subjected to the same mechanical conditions. Examples of this are: the identical character of the articulation of the limbs in Diplarthra and Rodentia which possess powers of rapid locomotion. The identical structure of the head of the radius in Edentata and Quadrumana which possess the power of complete supination of the manus. Identical reduction of the number of the digits under increased use of the limbs in many of the orders. Identical modification of dental cusps into longitudinal Vs and crescents under transverse strains in several orders, and into transverse crescents under longitudinal strains, in the Multituberculata. Identical modifications of the form and development of crests of the skull under identical conditions of use of the canine teeth for defence, in all the orders where the latter are developed.

II. Different structures appear in different parts of the skeleton of the same individual animals in consequence of the different mechanical conditions to which these parts have been subjected. Examples: the diverse modification of the articulations of the limbs in consequence of difference of the uses to which they have been put, in mammals which excavate the earth with one pair of limbs only, as in the fossorial Edentata, Insectivora, and Rodentia. The reduction of the number of digits in the posterior limb only, when this is exclusively used for rapid progression, as in leaping; this is seen

in the kangaroos and jerboas, in the orders Marsupialia and Rodentia.

There are a good many structures in the skeleton of the Mammalia which have not yet received a satisfactory explanation on the ground of mechanical necessity. Such, for instance, appears to me to be the condition of the history of the origin of the canine tooth; that is its use in preference to an incisor for raptorial purposes. Such may be also the history of the origin of the complex vertebral articulations of the American Edentata, as compared with the simple articulations of the Old World. In these, as in similar cases, however, an element enters which must be taken into account in seeking for explanations; that is, that every evolution is determined at its inception by the material or type from which it originates. Thus is explained the fact that identical uses have not produced identical structures in the limbs of all aquatic animals. The fin of the fish is essentially different from the paddle of the Ichthyosaurus or the whale. The beak of the rapatorial bird is different from the canine tooth of the rapacious mammal. When this principle is duly considered, many mechanical explanations will become clear, which now seem to be involved in difficulty or mystery.—*E. D. Cope.*

PSYCHOLOGY.

GRASSHOPPER REASONING.—I was on the railroad train from Newport, Vermillion County, for Terre Haute. A grasshopper in a heedless spring lit on the glass window of the coach. It was a warm, dry, dusty day of the drouthy summer. That little hopper looked through the glass and seemed astonished; the car was moving with increasing velocity, and thus surrounded by the current of air, the quiver and rattle of the car, seemed afraid to jump; and perhaps recalling the terrors of railroad accidents, was too cautious to fall off. So, calmly studying the situation, he decided to stay and ride to the next station.

On the polished surface of the giving, dusty glass, his feet became dry and his footing insecure. Mental resources came to his rescue. His memory and reason notified him that he must keep the suction cushions of his feet wet to insure an adhesive vacuum. So, after carefully planting his feet in safety, he carefully raised one foot to his mouth or lips and moistened it. It was a success, as reason and old memories and hopper philosophy had told him. Another and another foot was so moistened, and the hopper, armed with memory, prudence, and philosophic reason, rode on the train to the next sta-

tion, affording entertainment to several admiring friends. Hon. John Whitcomb, of Clinton, first called our attention to the cute little fellow.—*C., in Indiana Farmer.*

FROGS EATING SNAKES.—For several months I have kept in the house a sort of "zoological garden" in which there have been a few specimens of frogs, salamanders, and snakes. A few weeks ago I placed therein two full-grown leopard frogs and a hog-nosed viper about nine or ten inches in length. There were already in the box two garter-snakes two feet long and three salamanders—nothing else at that time. For a time everything went well, but about two weeks later the little viper was missing. A diligent search failed to find it, and careful examination of the cage showed no place of escape. The disappearance seemed quite mysterious, and the conclusion reached was that it had fallen a victim to cannibalism on the part of one of the other reptiles, although neither showed any signs of having feasted so extensively. Ten or fifteen days later a friend and I went to take a look at the pets. We found in the excrement of one of the frogs what on examination proved to be the skin, etc., of a snake, apparently the lost viper. When first found not more than half the length had passed, and the process was evidently causing the frog considerable effort. It was using its hind feet to assist in freeing itself.

Was the inference that the frog had swallowed the snake justifiable? I had never heard of such an occurrence; nor have I since been able to find any one who has. I was greatly surprised, for it seemed to me almost impossible. The swallowing of frogs by snakes I have several times seen, but I have never known the operation to be reversed, except in this instance.—*H. L. Roberts, Lewistown, Ill.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

THE AMERICAN HISTORICAL SOCIETY held its fifth annual meeting in the National Museum at Washington, D. C., beginning December 26, and continuing three days.

Among the many papers read, about the only one bearing upon Anthropology was that of Major Powell, introducing a "Language Map of North America." This map was displayed before the audience and the different Indian languages depicted thereon by different colors. An abstract of the Major's remarks and description is as follows:

[1] This Department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

"There is but one human species; but one human race. All differences are but variations of the one and original species. There were two great peoples of this one human species living on the two different hemispheres, unknown to each other. Columbus, voyaging from the one, discovered the other, and introduced them together. Further acquaintance developed the fact that even before his time there was a greater number of living languages in America than in Europe. If there was not more civilization, there was certainly more philosophy. We have failed to comprehend the extent to which this is true.

"Fifteen years ago I was called upon in my official capacity to classify the North American Indians. After various attempts and much consideration, I decided that the only practical or satisfactory classification was that to be made by language. Other persons had treated the subject in the light of zoology, and had attempted to classify man as an animal. Divers measurements of the crania were resorted to, anthropometry was put in active operation, tests were made of the color of the skin, hair, eyes, etc., but all such have failed as means of classification. We discovered as we progressed that classification by language was fundamental and wrought a classification in civilization, sociology, religion, mythology, art, etc.

"This map exhibits our conclusions so far as our work has been completed. It is intended to represent the condition and location of Indian tribes as manifested by their languages at the advent of the white man, though succeeding epochs have sometimes necessarily been shown.

"The Eskimos occupy the northern coast line like a fringe from Labrador to Alaska. They speak practically the same language. The Athabascan, occupying almost the entire territory of British North America, speak many languages, each distinct from the other, and yet belonging to the same stock and showing that they were the same people. We find this language scattered in spots through California and Old and New Mexico.

"The next group of languages, forty or fifty in number, scattered over the eastern and northeastern United States and Canada, was the Algonkin, and yet we find the Arapahoes down near the Gulf of Mexico to belong to the same stock. Likewise the Iroquois, variously called the Five or Six or Seven Nations, have a modern representative in the language of the Cherokees.

"The Siouan group had its habitat on the prairies between the Mississippi and Missouri. The Shoshonian group comprises twenty-five different languages. The Pueblo Indians employed four or five different stocks, but they all belong to the Shoshonian language.

"We have gathered material showing seventy-three different stocks of languages and nigh eight hundred dialects among the Indians of North America, and we have been aided in our work by the labors of missionaries, scholars, and of volunteers.

"Our work has made us more conservative. We now depend more

on evidence and less on theory. Our arrangement is based on the vocabulary—the roots of words. We have not depended upon the structure of their language. Structure means only different grades or degrees in development. A single language in its different dialects may exhibit at one and the same time both the highest and the lowest grade of structure or development. This is true of the Shoshonian. The language of some of the Indian tribes had a higher order of structure and a better grammar than had the English. The grammar of a language is born in barbarism.

"An attempt has been made in the present day, by a German, to construct a new language, and its inventor or maker has declared his purpose to take the good things of all languages and put them together for his new language. Suppose a zoologist should attempt to construct a new animal, or a new species, upon the same line, and, for instance, for the extremities of the body, he takes the hoofs of the horse, the wing of the bird, the fin of the fish, and the hand of man, and uses them all in the construction of his new animal because they all served a good purpose in the old. The result would be the same as in the new language, Volapük—the conglomerate monster of modern language."

We have seen the Linguistic Map of North America prepared by Major Powell and his assistants. It is a great work, worthy all commendation. The science had need for it, and it could scarcely ever have been done by private enterprise. It was fit and proper that it should be done under Government patronage, and all credit is due to the men who have made it.

In giving it this commendation, we do not at all assent to Major Powell's criticisms of other means of classification, and his laudation of language as the only correct or valuable one.

His may be, or may not be, the best system for the classification of the modern North American Indian tribes, but certainly is not for the real prehistoric races, whether of the Western or Eastern Hemispheres. However much we may theorize concerning their means of communicating ideas to each other, we are absolutely without knowledge as to the language they employed. But we make no dispute with Major Powell. This work done by him has enough of good in it to receive our approval, without wasting our strength in disputing over his criticism of other methods. The truth is, that all systems, all means, all methods, of determining the differences between the various Indian tribes, and, perhaps, between all races of men, are necessary and important in establishing the true classification. We may not pin our faith to one alone, but may use all, getting from each whatever of good it may furnish. The other method of classification will continue to be used, and Time, the great leveller, will set all things right. We can afford to wait.

Appropriations by Congress for the U. S. National Museum.—"England has become thoroughly aroused to the necessity

of encouraging science and art. Availing herself of the fifty thousand volumes and the hundreds of cases of natural history left by Hans Sloane, a native of Ireland, she founded the British Museum. Later in the century she spent half a million dollars on the National Gallery, and has annually bestowed upon it a liberal allowance. The South Kensington Museum, the National Portrait Gallery, and the India Museum are all of comparatively recent origin, and have cost the Treasury millions for their foundation and support. Museums of art have been opened in the provincial towns, supported in part by corporate, in part by private, and in part, indirectly, by Parliamentary aid. The effect of Kensington and other training-schools upon the industry of England has been such that last year a leading French authority cried out that if France did not bestir herself, England would take from her the markets of the world, which the superior technic and taste of the French designers have monopolized for a century, or since the establishment of art schools throughout France. Parliament expended last year upon the science and art of England nearly $5,000,000, and upon science and art in Ireland nearly $300,000."—*Margaret F. Sullivan, in December Century Magazine.*

If comparisons were not "odorous," one might be drawn between the policy and action of the United States Government and that of Great Britain as set forth in the foregoing extract.

The United States National Museum is the only institution supported by the United States Government which stands as a representative of the British institutions mentioned above, and on which its Government has spent millions.

The appropriations made by the United States Government for the National Museum are barely sufficient to keep it alive. They are provision for its daily running expenses, and barely adequate for that. What the museum, its contributors and correspondents, persons throughout the country interested in kindred scientific pursuits, and the public generally, have good right to complain of is that no provision is made in these appropriations for the purchase or securing of specimens, however great their value or importance, nor for the enlargement or increase of the collections. The Congress, it would seem, fails to comprehend the scope and purpose of the National Museum. It seems to consider it as a mere gathering of curiosities (maybe monstrosities) which may serve to amuse and interest for an afternoon a stray constituent who may have come in from the rural districts and seek attention at his Congressman's hands. The Congress at large seems not to know, or, if it does, ignores the fact that the National Museum is an extensive, and ought to be fully equipped, organization for the education of the people and for conducting investigations in science not possible to be done by private individuals.

In other countries it would be liberally supported and generously sustained. With a geographic area larger than combined Europe the United States treats its science, especially its science of archæology,

with less interest, or care or attention, if we measure these things by the appropriations made, than do the third-rate powers, such as Portugal, Denmark, Sweden, Switzerland, etc. Yet the area of the United States is as rich and as new, and will pay as largely for cultivation, as any like area in Europe. The States of Ohio, or Wisconsin, or West Virginia, or Mississippi, not to mention New York or New England, have either of them within their borders as much unstudied, unsearched, and unclassified archæologic riches as has any one of the great countries of Europe: England, France, Germany, Spain, or Italy. Yet these countries, each of them, do more for their archæology than equals the combined efforts of the United States and all the State governments.

I confess to a feeling of depression when, on visiting the Prehistoric Museum at Salisbury, England, I found there stored and displayed, in a beautiful building, erected in the midst of a lovely park, for its sole occupancy, the prehistoric collection of Squier and Davis, gathered by them from the mounds of the United States in the Ohio and Mississippi valleys. It went begging through the United States, knocked at the door of Congress, and besought a purchaser at the ludicrous price of $1000, but without finding a response. And in disgust with their countrymen, and in despair of ever being able to interest their Government or fellow-citizens, they sold their collection to England and retired from the field of archæologic investigations.

The National Museum courts the fullest investigations into its mode of conducting business. It is willing to be held to the strictest accountability for its expenditures. These should be made imperative. But it should receive at the hands of Congress an intelligent co-operation and a generous response to its efforts for the elevation and education of our people.

The Secretary of the Smithsonian Institution and Director of the National Museum has labored with all zeal to establish a zoological park and garden in the environs of Washington for the preservation and display of our native wild animals, now rapidly on the road to extinction. Looking in that direction, a few of these animals have been received as gifts under the promise that they would be protected and cared for. And they have been established in temporary wooden buildings, and a park, with a wire fence around it, as big as an onion patch, in the Smithsonian grounds, in expectation that they might form the nucleus of a future zoological park and garden. The House Committee on Appropriations seem to calculate or figure how much refuse meat, how many bushels of corn and bales of hay, how little of provision would support these animals, keeping them from starvation during the coming year, and so has reduced the appropriation by one-half from the estimates. One might suppose that the Secretary, meeting with such responses, would grow weary of his efforts in well-doing and retire from the further contest disappointed, if not in despair.

However, the people of the United States are not niggardly in

the matter of money needed for the benefit of science, if the object be properly explained and fairly understood. It rests upon the Secretary and Board of Regents to do this, and the people will justify them in asking for any reasonable amount so long as they shall be satisfied, as they may be under the present administration, that it is honestly expended and faithfully accounted for. Legislators seeking a reputation for economy will not be sustained by the people in refusing to vote the appropriations sufficient to secure, in these matters, a degree of excellence which will cause the United States to compare favorably with other countries.

FORGERIES OF PALÆOLITHIC IMPLEMENTS IN EUROPE.—Mr. John Evans, of Nash Mills, Hemel Hempstead, England, the distinguished numismatist and prehistoric archæologist, says in a private letter lately received : "We have lately had very extensive forgeries of palæolithic implements in the neighborhood of London. Many of them are of great size and remarkably well made. Several collectors have been taken in, and I should not be surprised if some of our dealers exported a few to America. I recommend you to be on your guard."

Monsieur Boucher de Perthes, of Abbeville, the discoverer of the palæolithic age and implements in the valley of the river Somme, was often deceived by the workmen on whom he had to depend in his search for these implements. It was in the beginning of all knowledge of this subject, and no one could claim to be an expert or have much experience in their detection. Monsieur Boucher de Perthes stored his collection, if he did not make it a donation, to the Archæologic Museum of the town of Abbeville, and died without knowlege of the frauds of which he had been the victim. His son-in-law, M. D'Ault Dumesnil, the geologist, equally learned and practised as a prehistoric archæologist, became director of that museum. In the classification made by him of the palæolithic implements he detected the forgeries and withdrew them from exhibition. The United States National Museum has to thank him for a series which are there exhibited as specimens of these forgeries. So habile did M. Dumensil become in the detection of these forgeries that he was able to tell from an inspection of them, not only when they were forgeries, but from their peculiarities he could determine the identity of the forger. The "personal equation" was so manifested in this work as to enable him to do this.

INTERNATIONAL CONGRESS OF PREHISTORIC ANTHROPOLOGY AT PARIS, 1889.—The International Congress of Prehistoric Anthropology will profit by the French Exposition of 1889, and hold a meeting at Paris, in August of this year. These Congresses were organized in 1866–67, and have held their meetings in various capitals of Europe with greater or less regularity until the last one at Lisbon, in 1880. A session was organized for Athens, in 1883, but failed, owing to the rumors of approaching war. We are glad to hear of this revival at Paris for 1889.

A few individuals (I do not know whether they were enough to make it the plural number), living less that a hundred miles from the city of New York, having a greater desire for notoriety than to benefit the human race, attempted last spring and summer to organize a private international congress of prehistoric anthropology. The list of complimentary officers, Vice-Presidents, etc., was formidable, and comprised most, if not all, distinguished foreigners, and the farther away the more there were of them. The list appeared to have been copied from the records of some young and ambitious anthropological society, and to have contained all its honorary associates and corresponding members. The scheme was doomed from the beginning, as an international affair, for, while no anthropologists at home were consulted, or at least gave their adhesion, the time was too short to perfect arrangements with foreign countries and have their societies represented. But one foreigner of any note attended, and he—well, he concealed his disappointment with that suavity which belongs to his nation. No great harm was done to the science of prehistoric anthropology by the failure of this pretended International Congress, for no one was greatly deceived; but its instigators should take warning from this attempt and not repeat the fiasco. Think of getting up such a congress without the co-operation of any of the members of the anthropological section of the Association for the Advancement of Science, and without a representative from any of the anthropological societies of the United States except the local one interested.

Anthropological News.—Dr. A. B. Meyer, of Dresden, writes to *Nature* (XXXIX., p. 30) to state that there are no autochthonic Papuans or Negritos in Celebes, and to express doubts of their occurring in other islands to which they are attributed by Quatrefages and Flower.

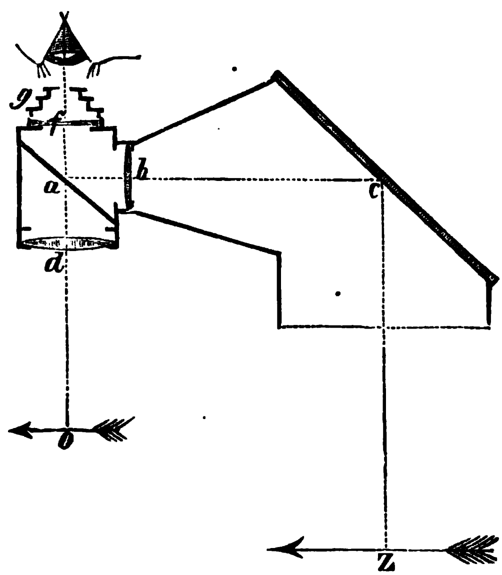
The first discovery of remains of cave-dwellers in Scandinavia has recently been made in a cave on a small island near Gottland. The remains consisted of the old fireplaces, and the bones of various animals, pottery, flint chips, etc. Most of the bones had been broken to extract the marrow. In the upper strata the bones of pigs, horses, etc., predominated, but in the lower those of seals increase.

During the past summer the museum at Copenhagen has explored a large kitchen-midden in Jutland, situated in a forest a couple of miles from the sea. Besides the usual assortment of bones and shells, many flint implements and fragments of pottery were found, as well as some bone and horn tools, a few of the latter showing traces of ornamentation.

MICROSCOPY.[1]

Thoma's Camera Lucida.[2]—The cameras now in use are not well adapted for a low magnifying power (1–6), nor is any allowance made in their construction for the refractive index of the eye. In order to obtain sharp images one is often obliged to bring the drawing-paper nearer the eye, thus materially reducing the field of vision.

In the construction of Thoma's camera the above difficulties are avoided, and it is specially recommended for drawing with a magnifying power of from 1–10 times, and for the production of *reduced drawings.*



1.

The camera consists of a blackened, metallic frame containing two mirrors, one of which, fig. 1,*a*, is an unsilvered glass plate from 0.15 to 0.20 mm. in thickness, while the other (*c*) is a plain silvered mirror. Both mirrors are parallel with each other and inclined at an angle of 45° to the horizon.

In order to draw an object magnified four times, we place at *o* a convex eye-glass with a focal distance of 40 cm., and then fasten the camera upon the vertical rod so that the distance $b\ c$ and $c\ z = 40$

[1] Edited by C. O. Whittman, Director of the Lake Laboratory, Milwaukee.

[2] Zeitschrift f. wiss. Mikroskopie, v. 3, p. 297, Sept., 1887.

cm. As the distance $b\ c$ is constant, 10 cm., $c\ z$ must be 30 cm., and may be easily found on the ruled rod that supports the camera.

Next a convex eye-glass of 10 cm. focal distance is inserted at d, and the upper end of the sliding ring to which the stage is attached brought within 10 cm. of the lower edge of the ring to which the camera is fastened.

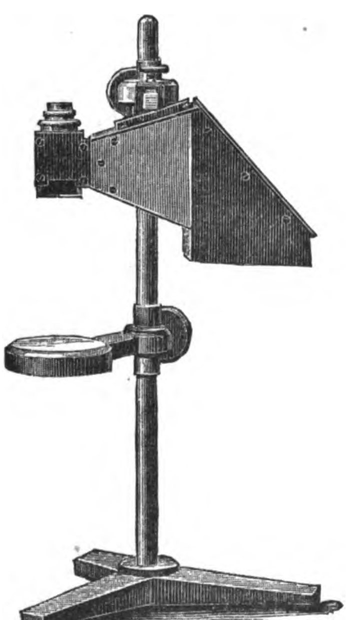
The amount of light is regulated by means of smoked glasses inserted above the convex glass at d.

If the eye of the observer is myopic. it is necessary to insert at f an eye-glass for correction. A myopic person will often find it convenient to use a glass a little stronger than is required in looking at distant objects.

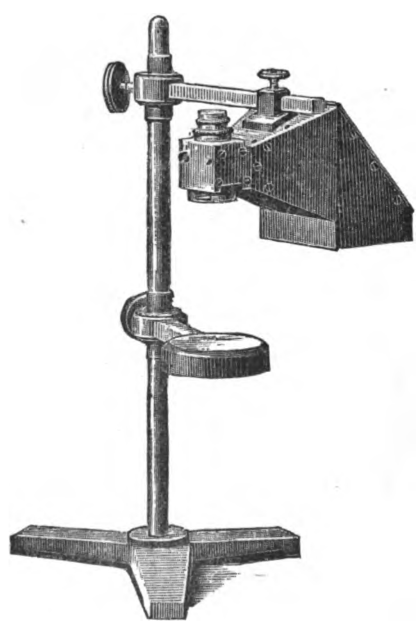
Finally, in all cases, except where a magnifying power of from 1 to 2 times is used, a diopter (g) must be placed above f. In using the high magnifying powers the focal points of both systems do not exactly coincide, so that a parallactic displacement of the images is produced, if the diopter is left out. This is a defect of all cameras and is usually corrected by the use of small prisms, while here the same object is equally well, and at the same time more conveniently, accomplished by the diopter.

The magnifying power is equal to the ratios of the distances. $b\ c\ z$ and $d = 40 : 10 = 4 : 1$.

In using the camera, it must stand before the observer, as in fig. 2, with the drawing on the right and the diopter and object on the left.

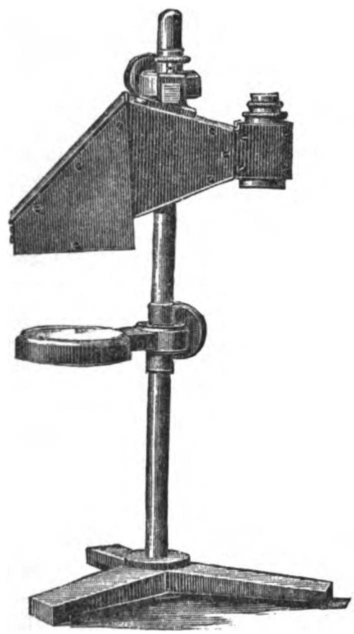


2.



3.

Only in using a magnifying power of from 1–1½ times is the position of the camera reversed, the drawing and object maintaining the same position as before (fig. 4). In this way we look directly at the drawing, while the object is seen through the two mirrors.



4.

For other powers than that given above, the following table may be used:

MAGNIFICATION TABLE.

I.

Diopter and object on the left, drawing and silvered mirror on the right, as in fig. 2.

Diopters of the convex lens necessary at *d* in fig. 1.	Smoked glass, No.	Distance of the object from the convex lens *d*.	Magnification	Diopters of the convex lens necessary at *b* in fig. 1.	Smoked glass, No.	Distance of the drawing paper from the convex lens *b*.
+ 15 = 10 + 5	c	66 mm.	6	+ 2.5	—	400 mm.
+ 12.5 = 12 + 0.5	c	80	5	+ 2.5	—	400 "
+ 10	c	100	4	+ 2.5	—	400 "
+ 10.5 = 10 + 0.5	c	95	3½	+ 3	—	333 "
+ 7.5	d	133	3	+ 2.5	—	400 "
+ 6.25 = 6 + 0.25	d	160	2½	+ 2.5	—	400 "
+ 5	d	200	2	+ 2.5	—	400 "

II.

Object and silver mirror on the left, diopter and drawing on the right, as required for a magnification of 1–1½ times, as in fig. 4.

Diopters of the convex lenses necessary at b in fig. 1.	Smoked glass, No.	Distance of the object from convex lens b.	Magnification	Diopters of the convex lens necessary at d in fig. 1.	Smoked glass, No.	Distance of the drawing paper from the convex lens b.
+ 5	—	200 mm.	1½	3.25=3+0.25	d	300 mm.
+ 4	—	250 "	1	+ 4=3+1	c	250 "

When in use the whole apparatus is placed upon the drawing-paper, which serves as the source of transmitted light, but reflected light may be used equally well.

One advantage of this camera is that, even with low powers, the field of vision is very large, so that objects from 6–10 cm. in diameter may be drawn. By placing the object in the place of the drawing, and the drawing in place of the object (using the above table), one can reduce the magnification from 1–⅙.

While it is easy by means of the concave glasses to accommodate any eye to the instrument, the apparatus is also a safe and convenient help in laboratories, even to the unexperienced. But as in all such instruments it is better to draw a ruler at the same time with the object.

If one who is able to see clearly with the above combination by inserting at *f* a concave glass of —5 diopters, then, since the distance of this glass from the convex lenses is 3.8 cm., the concave lens may be omitted and the convex lenses at *b* and *d* replaced by others, 6.25 diopters smaller. With a concave glass of + 5 D. at *f*, it is possible to obtain a magnifying power of 8 times by inserting at *d*, 50 cm. from the object, a convex glass of + 20 D., and at *b*, a convex glass of + 2.5 D., 400 mm. above the drawing-paper. If the concave at *f* is omitted, then, leaving object and lens in same position as before, it will be sufficent to place at *d* a convex glass of + 20 — 6.25=13.75 diopters, and at *b* one of + 2.5 — 6.25= — 3.75 Ds. One may thus obtain an 8-fold power without using too strong glasses. For eyes of a different refractive index, the number of diopters to be deducted changes.

If in the previous combination it is necessary to have at *f* a concave glass of — 1 D., this may be removed by deducting 1 D. from the glasses at *d* and *b*.

In the same way,

A concave	glass of	— 2	D's at *f*,	may be	replaced by	— 2.16	D's at	*d* and *b*.
"	"	— 3	"	"	"	— 3.40	"	"
"	"	— 4	"	"	"	— 4,72	"	"
"	"	— 5	"	"	"	— 6.17	"	"
"	"	— 6	"	"	"	— 7.75	"	"
"	"	— 7	"	"	"	— 9.52	"	"
"	"	— 8	"	"	"	—11.50	"	"

If in the first named combination a concave glass of — 2 D. is

necessary at *f*, a myopic condition of — 8 D. may be produced if a convex glass of + 6 D's is placed in front of the one at *f*.

In the same way:

For an eye of		— 3 D's—	we must add			+ 5 D.
"	"	— 4	"	"	"	+ 4 "
"	"	— 5	"	"	"	+ 3 "
"	"	— 6	"	"	"	+ 2 "
"	"	— 7	"	"	"	+ 1 "
"	"	— 8	"	"	"	0 "
"	"	— 9	"	"	"	— 1 "
"	"	—10	"	"	"	— 2 "

in order to produce a myopic condition of — 8 D's. When this condition is produced, we may obtain higher magnifying powers, as follows:

III.

Diopter and object on the left, drawing and silver mirror on the right, as in figure 2.

Diopters of the convex lens at *d*.	Smoked glass, No.	Distance of the object from the convex lens *d*.	Magnification.	Diopters of the concave lenses at *b*.	Distance of the drawing paper from the convex lens *b*.
+7	d	57 mn.	7	—9	400 mm.
+8.5 =7.5+1	d	50	8	—9	400 "
+11 = 6+5	c	44	9	—9	400 "
+13.5 =7.5+6	c	40	10	—9	400 "

These combinations produce perfect images, except when the strongest magnifying power is used, when a slight distortion is visible on the edge of the field of vision.

The above described camera, together with a case of 25 glasses, may be obtained of R. Jung, Mechanic and Optician, in Heidelberg, for 120 marks.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Society for Psychical Research; Boston, Dec. 12, 1888.—Dr. J. W. Warren read the report of the Committee on Mediumistic Phenomena, of which the following is the substance:

"Your committee desires to report a moderate progress in the investigations pertaining to its work. During the year the committee, as such, has undertaken the careful examination of the results obtained by one well-known trance medium. We were aided very materially by the generous co-operation of the medium. Thus far we have been able to have only light on 10 sittings, stenographically reported. The results thus obtained are not of such a character as to warrant any very decided judgment as to the nature of the phenomena under examination, but they throw some light on the questions involved. An extension of the investigation would be very desirable, provided a sufficient amount of money could be placed at our disposal. As to materializing or etherealizing mediums, it is learned that seven—nearly every one of whom had been highly recommended to our special attention—have come to grief here in Boston during the past two or three years. Still, we are ready to examine these phenomena on the receipt of tangible experiences on the part of trustworthy persons, provided we are permitted to impose such conditions as seem to us reasonable and necessary."

Secretary Richard Hodgson read the report of the Committee on Thought Transference. In the experiments made by this committee, an attempt was was made to "will" the subject to name a number selected by the other party to the experiment. By pure chance, one might be expected to guess 10 numbers out of 100 correctly, but the results varied in each series of 100 from 10 to 28. Out of 3000 numbers selected, 584 were guessed correctly, instead of 300, which fact, the members of the committee think, points to some other influence than chance. It was noticed that when the right guess was made in the first place, the subject displayed no desire to change it, and it was only in cases where the first guess was wrong that the subject showed any uncertainty in announcing it, or attempted to change it afterward.

Prof. J. Royce read the report on phantasms and presentiments. He declared that, in his opinion, the methods of research adopted by the committee on phantasms and presentiments had been justified by the results obtained. After he had stated the subdivisions he had made of his subject, he gave his special attention to what he called "pseudo-presentiments" and to coincidences that seem to have some bearing on telepathy. Under the head of pseudo-presentiments he cited a number of cases where individuals, after events have happened, persuade themselves that they had presentiments of the events before they occurred. He also spoke of the feeling people often have, when visiting a strange place, of "having been there before." These hallucinations, he said, were attributable to surprises which make so strong an impression upon a man's mind as

to lead him to think that the subject has long had a lodgment in his brain. He spoke of three cases of telepathic coincidences, supported by documentary evidence, but these were all of them mentioned in his report of last year. These cases he considers very valuable for the purposes of the society, but as to the cause for them he expressed no opinion.

Dr. James made a short speech, setting forth the aims and needs of the society. It was the intention to extend the work of the society, and that specially interesting psychical cases in all parts of the country were to be scientifically investigated. Information in regard to alleged haunted houses was often received, many of which the society was unable to investigate, owing to a lack of funds, but there were over 700 cases now being investigated. The society, in self-defence, would be forced to publish more than it had ever done before, and all these matters required money. The new members, he said, had more than supplied the loss by withdrawals, so that the society was growing a little.

Biological Society of Washington.—December, 15, 1888.—The following communications were read: Prof. Lester F. Ward, "Fortuitous Variation as Illustrated by the Genus *Eupatorium*, with exhibition of specimens;" Prof. C. V. Riley, "Note on a Human Parasite;" Mr. E. S. Burgess, "*Aster shortii* near Washington."

December 29.—The following communications were read: Dr. Theobald Smith, "Contagion and Infection from a Biological Standpoint;" Mr. F. A. Lucas, "Notes on the Diseases of Menagerie Animals;" Mr. Th. Holm, "Notes on *Hydrocotyle americana* Linn.;" Dr. Cooper Curtice, "Notes on the Sheep Tick, *Melophagus ovinus* Linn."

SCIENTIFIC NEWS.

— Dr. G. Ruge, of Heidelberg, has been called to the Professorship of Anatomy at Amsterdam.

— The results of the explorations of the late N. M. Prjewalski in Central Asia are to be published by the Imperial Academy of Sciences of St. Petersburg, at the expense of the Crown Prince Nikolas Alexander. The first part of the first volume of Zoology has appeared and contains the Mammals by E. Büchner. Prjewalski was just starting on a new journey to Central Asia when his death occurred, Nov. 1, at Karacol. He belonged to a noble family and was born in 1839. His first Siberian journey was undertaken with ridiculously small means; it lasted thirty-four months and cost 6000 roubles ($4200). His second journey (1877) was under the auspices of the Russian War Department and resulted in the rediscovery of the Lob-Nor, which had not been seen by a single European since the days of Marco Polo. His third journey resulted in his discovery of the ancestor of the domestic horse (*Equus prjevalskii* Poliaeff). The fourth journey (1883) had for its objective point Thibet, and the fifth, on which he had just started when his death occurred, was an attempt to reach H'lassa, the sacred city of Lamaism. Prjewalski's natural history collections embraced 700 specimens of mammals, 5000 birds, 1200 reptiles and batrachia, 800 fishes, 2000 molluscs, 10,000 insects, and between 15,000 and 16,000 plants.

— Prof. A. C. Haddon, of Dublin, who sailed last summer for Torres Strait, has arrived there safely, and is engaged in studying the Sea Anemones, Nudibranchs, and the habits and placentation of the dugong or southern sea-cow. He is also collecting all the ethnological material obtainable, as the native population is rapidly dying out.

— The Copley Medal of the Royal Society is this year awarded to Prof. T. H. Huxley for his investigations on the morphology and histology of vertebrate and invertebrate animals. Baron Ferdinand von Müller receives the Royal Medal for his investigations of the Flora of Australia.

— The Costa Rican government has established a National Museum at San José.

— Samuel P. Fowler of Danvers, Mass., died Dec. 14, 1888, aged 88 years. He was a contributor to the AMERICAN NATURALIST in its early years.

— Prof. T. Kjerulf, the well-known geologist of Christiania, Norway, died in that city, Oct. 25, 1888.

— Mr. Francis Darwin has been elected University Reader in Botany in the University of Cambridge in succession to Dr. Vines, now Professor at Oxford.

— Mr. Charles B. Cory, chairman of the Committee on Hypnotism of the American Society of Psychical Research, has issued his report. He believes that its use in connection with nervous diseases is worthy of consideration.

— Mr. H. A. Pilsbry is continuing the Manual of Conchology, Structural and Systematic, begun by the late Geo. W. Tryon. Part 39 of the first and Part 15 of the second series have recently been issued.

— G. Bellonci. Professor of Anatomy in the University of Bologna, died July 1, 1888, aged 30 years.

— G. Johann Kriesch, Professor of Zoologv in the Polytechnicum at Budapesth, died October 21, aged 54 years.

— Dr. Robert Lamborn has presented a cast of the *Phenacodus primævus* to the American Museum of Natural History, New York. He has also deposited a fine collection of Mexican antiquities in the Metropolitan Art Museum, New York, and a collection of Tuscan antiquities in the Museum of the School of Industrial Art, Philadelphia.

— Professor Joseph Leidy, of Philadelphia, has received the Cuvier prize of the French Academy of Sciences in recognition of his important work in Natural History.

— A work on the Extinct Mammalia, by Professors Scott and Osborn, of Princeton, N. J., has been announced by D. Appleton & Sons, New York.

— Mr. E. T. Dumble has been appointed State Geologist of Texas.

— Prof. J. T. Branner recently reported unfavorably on the supposed silver and gold mines of Arkansas, of which State he is Geologist. The abuse he received from the papers of the alleged mining regions was extraordinary and unparalleled, but when he offered to submit the question to the judgment of other geologists, they did not accept his challenge.

Two Interesting Models for Anatomical Studies.—Everybody who has visited the British Museum of Natural History in London has noticed the highly instructive anatomical preparations in the Central Hall of this wonderful building. A great part of these preparations are made by the very skilful hand of Mr. Richard S. Wray, B.Sc., one of Prof. Flower's assistants.

Besides these specimens Mr. Wray has prepared some very good models for the Museum; two of these can be now obtained from him.

1. Model of Amphioxus, showing the general relations and dispositions of the organs as seen from the left side. Price, £2 2s. ($10, about.)

This is a reproduction of the original wax model forming part of the series of models and drawings prepared to illustrate the structure of Amphioxus for the Index Museum of the British Museum (Natural History). The different organs are distinctively colored, and the model shows at a glance all the more important anatomical relations of the animal. The disposition and relations of the central nervous system, notochord, alimentary canal (pharynx, liver, anus, etc.), the epipleural cavity with its backward extension towards the anus, the cardiac and dorsal aortæ, are all clearly shown together with other details.

2. Enlarged model of the left side of the lower jaw of a young Ornithorhynchus, showing the tooth germs *in situ*. Price, 10s. 6d. ($2.60, about.)

The following quotation from the label attached to the original preparation and model in the Index Museum of the British Museum (Natural History) will fully explain its nature:

"In the Ornithorhynchus teeth are absent in the adult,................ In the young state, there are, however, distinct tooth rudiments with calcified cusps, beneath the region in which the horny plates are afterwards developed.

"The small glass vessel contains the left side of the lower jaw of a young Ornithorhynchus, prepared to show the tooth germs *in situ*, the characters of which are more clearly shown in the enlarged model placed by it."

Communications relating to the above to be addressed Richard S. Wray, 23, St. Germain's Road, Forest Hill, London, S. E.

I can only recommend these highly instructive models to every student of Biology. G. Baur, New Haven, Conn.

$4.00 per [redacted]. 40 Cts. a Co

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IN THEIR WIDEST SENSE.

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CONTENTS:

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A CONTRIBUTION TO THE KNOWLEDGE OF THE GENUS BRANCHIPUS.

BY O. P. and W. P. HAY.

1. *The Hatching of the Eggs of* B. VERNALIS *Kept in Dried Mud.* *Branchipus vernalis* is, according to our present knowledge, distributed from Eastern Massachusetts to Western Indiana. It lives in ponds which are filled with water during the colder parts of the year, but which are dry during the summer months. The eggs, therefore, which when laid by the females sink down into the mud, remain during the hot months enclosed in the dry and baked earth and resume their activity and complete their development only when the cold autumn and winter rains come on.

The species of Branchipus whose life-history has been most thoroughly studied is *B. stagnalis* of Europe. As long ago as 1820, Benedict Prevost experimented with its eggs. Some of these were kept in dried mud for six months and at the end of that time on being put in water developed into swimming larvæ. Some of the eggs, similarly dried, were sent to M. Jurine at Geneva, and this naturalist also succeeded in obtaining the young.[1]

Naturalists have hitherto not been so successful in hatching out the eggs of our species. In Dr. A. S. Packard's "Monograph of

[1] Claus, *Branchipus stagnalis*, etc. Göttingen, 1873, p. 1.

the Phyllopod Crustacea of North America,"[1] Dr. Paul F. Gissler gives the results of his efforts to obtain the larvæ from dried mud :

"During the whole summer of 1880 I experimented with dry mud from ponds inhabited by either the normal or pale race of this Branchiopod, but all in vain. Neither jars kept on ice in a large refrigerator, nor frozen dampened mud, gradually or suddenly thawed, developed any larvæ. The mycelium of a fungus, a few Daphniidæ and microscopic organisms were the only result."

Some time during April, 1888, the junior author collected a considerable number of females of *B. vernalis*, and selecting such as had their ovisacs filled with eggs, put them into a jar of water, in the bottom of which was placed earth taken from the garden. These females were allowed to remain here until they died, which was within about two weeks. The water was allowed to evaporate, the mud became dry and was moistened only once or twice during the summer. It was, of course, as dry as dust the greater portion of the time. On September 27, this dirt was broken up and put into another jar and covered with water. Immediately numbers of the eggs came to the surface and remained floating there about two days, when they went again to the bottom. On October 9, larvæ were, for the first time, observed swimming about in the jar and soon large numbers appeared. This experiment proves that the hatching of the larvæ of *B. vernalis* is by no means difficult to bring about, and that we may almost at will obtain them for observation. It also shows that it is not necessary that the eggs should ever be subjected to a freezing temperature.

That we have in our experiments succeeded in getting a view of the larvæ immediately after their exclusion from the eggs, we are not wholly certain. They could, at all events, have escaped but a short time before they were seen. One specimen was observed while in the act of escaping from the egg-shell ; but the specimen seemed to be unable to extricate itself and may have been sticking there for some time and meanwhile undergoing change.

One thing, however, appears to be evident, namely, that the larva differs in some important respects from that of *B. stagnalis* as figured and described by Dr. C. Claus in his paper, "*Zur Kenntniss des Baues und Entwickelung von B. stagnalis und Apus cancriformis;*"

[1] U. S. Geol. and Geog. Survey Wyoming and Idaho for 1878. Washington, 1883.

and it is highly probable that it leaves the egg in a more advanced stage of development.

According to Dr. Claus the nauplius of *B. stagnalis* on leaving the egg is of a dull yellow (*trubgelb*) color, which has, as its cause, a multitude of bright granules and globules, and this color is so decided that for some time the view of the internal anatomy is obscured. The larva of *B. vernalis*, on the contrary, is very pale, and will, therefore, more readily lend itself to investigations on the early condition of its internal organs.

In the case of *B. stagnalis* the post-cephalic portion of the body is at first globular, but later becomes more elongated and oval,and finally, when the limbs have begun to bud out, changes to a conical form. The same portion of the body of *B. vernalis* is from the first proportionately shorter and broader. Furthermore, there are, in the earliest stages seen by us, the lateral buds of three or four pairs of post-maxillary appendages. The most striking difference between the larvæ of the two species appears, however, to be found in time of appearance of the paired eyes. According to Claus those of *B. stagnalis* do not appear until the first and second pairs of thoracic segments have become four-lobed and ten or eleven segments have been marked out. The larva of *B. vernalis* appears to possess both the median and the paired eyes at the time of escape from the egg; at least the paired eyes are plainly visible in the earliest observed stages, when there are but the merest swellings to indicate the positions of the first four thoracic limbs. Thus the true nauplius condition of *B. vernalis* appears to be passed through before the larva escapes from the egg; it is excluded as a metanauplius.

It is interesting to note that the larva which we saw endeavoring to escape from the ruptured egg-shell was enveloped in a thin transparent membrane. Whether this was the inner egg-membrane or a blastodermic moult we do not undertake to say. Zaddach's observations on Apus will be recalled in this connection. (*De Apodis cancriformis, 1841*).

Our smallest larvæ measured in length ⅔ inches.

II. *Description of a supposed new species of Branchipus*, B. GELIDUS. Male conforming closely to the description of *B. bundyi*, Forbes[1], except that the caudal stylets are linear-lanceolate instead of broad and blunt. Frontal appendages long and narrow. Clas-

[1] Illinois Museum Nat. Hist., Bulletin No. 1. p. 25.

pers grooved on inner side near the tip, and terminally tridentate rather than bifid, there being a third process which is situated on the anterior edge of the tip of the clasper; this process rounded instead of pointed. Female characterized by a structure that could hardly have been overlooked had it been present in *B. bundyi*. This consists of two prominent processes of a conical form that grow out from the dorso-lateral surface of the tenth thoracic segment, one on each side, and project backward, across the eleventh segment and for a short distance on the segment that contains the genital organs. The posterior ends of these processes stand out free from the body. The ninth segment with a similar but much smaller process on each side, which overlaps the one on the tenth segment. Ovisac about as broad as long and with a prominent median process.

The function of these dorsal outgrowths is not known to us. It may be suggested that they furnish means for the male to retain firm hold of the female. The claspers of this species are far less powerful than are those of *B. vernalis* and may not be alone equal to the task imposed on them. Possibly the rounded tubercle found at the base of the second joint of the claspers is applied to the processes on the back of the female and hold retained by means of the minute suckers on the tubercles.

In order to ascertain the nature of the outgrowths found on the females, consecutive series of sections were cut from hardened and stained specimens. The organ in question is, of course, bounded outwardly by a chitinous wall; but it is also, at most points, distinctly separated from the rest of the body by another wall of chitin. This is, however, incomplete, so that the cavity of the process is in communication with the cavity of the body. From the interior wall there radiate outward to the external wall a great number of bands or trabeculæ also apparently of chitin. These bands,as they pass outward, divide and anastomose so that the interior of the process is divided into communicating cells. Where the process frees itself from the body these bands soon cease to be seen. For some little distance behind the points where the processes leave the body there is found, along the middle of the back, the double-wall arrangement, with chitinous bands running from the inner wall to the outer. In the meshwork of chitinous bands, especially of the processes, there are found numerous small nucleated cells or corpuscles. The extremities of the processes are filled with these.

As to the habits of this species little is known. In the pond where large numbers occurred in the spring, no specimens of *B. vernalis* were seen. This fall when the same pond was visited not a specimen of the new species was to be found, while *B. vernalis* abounded.

It was observed that while the males were swimming about, the long and narrow frontal appendages were frequently rolled up and again extended. They present under the microscope a beautiful network of muscular fibres, in the meshes of which are numerous ganglionic cells.

A CORNER OF BRITTANY.

By J. WALTER FEWKES.

"BILLET pour Roscoff, s'il vous plait." The train is waiting a the Gare St. Lazare in Paris, and in a few moments we are hurried along beyond the fortifications, past Bellevue, Sevres and Versailles, through a wooded country, alternating with rich farms and beautiful fields. All day long we ride through Normandy and Brittany, looking out of the window of the coupé on one of the most interesting landscapes of France, crowded with towns and cities of historic interest and scenic beauty, every hour presenting some new phase of life to relieve the monotony of the trip. What is our destination and what leads us to turn from the beaten tracks of European travellers? We have abundant time to answer these questions before we reach the end of our journey.

Our destination is Roscoff, a town in the department of Finisterre, frequented by artists, better known to naturalists, and too rarely visited by travellers, who have penetrated into all the most picturesque corners of Europe. Roscoff, a fishing village, truly Breton in character, preserving many features of the old France, and presenting a pure example of ancient Brittany, unchanged by modern innovations. Roscoff has not a casino nor knows the swarms of pleasure seekers which many other towns on the coast of France draw to themselves every summer. It has no delightful promenades, no beautiful forests, but it has its wonderful rocks, its soft, laughing ch-

mate, its southern flora, its fertile lands, its hardy fishermen with their original costumes, its picturesque homes, and its beautiful church. Of more importance than all to the naturalist, it attracts him as the site of one of the most interesting of all those institutions for the study on the sea-shore of marine animals, the Laboratoire Experimentale et Générale, founded by Prof. Lacaze-Duthiers. It is this establishment which turned me to this distant corner of Finisterre, where I was permitted to spend two of the most charming months of a summer's vacation in Europe.

Roscoff is situated on the confines of Brittany, on a peninsula which juts out into the English channel, about opposite Plymouth in England. Away from beaten lines of travel it is unaffected by the changes which are being made in the larger cities about it, and remains, as it was when Mary Stuart landed on its shore, a veritable survival of the old Brittany of three centuries ago. Artists know it, and naturalists have long studied the rich life which peoples its coast and the waters which bathe its shores. Lovers of nature find there a sea most savage, and cliffs most rugged and picturesque. The blue sky of the Mediterranean and the beautiful water ever changing and never tranquil are here. Its islands are eroded by the ocean into fantastic shapes so that their contours rival our own "Garden of the Gods" in their grotesque shapes. The whole appearance of the coast, changed in a few hours by the great tides, the wonderful scenery on all sides, these are some of the beauties of nature which once seen retain the visitor in this interesting place day after day and week after week.

The place is situated on a small peninsula, the main street extending along the sea, and terminating at either end on the coast. Near one end of this street there rises a bald cliff capped by an ancient chapel of Sainte Barbe and a small fortress called the Bloson. At the other end this road broadens and opens into a place called the Vil upon the sides of which arise the Hotel du Bains Mer, the church, and the Marine Laboratory. On either side the main street of the town is lined with picturesque old houses, many of which date three centuries back, bearing the stamp of an old civilization. Small side passages lead to the shore on one side of the street, while on the other are narrow passage ways leading into tortuous alleys which extend out into the cultivated fields. Midway in the course of the main street, between the chapel of Sainte Barbe and the Vil or place of the church, is the port, an artificial structure, forming a

high breakwater in the hospitable protection of which lie a few small craft. At high tide these vessels swing at anchor, but the retreating sea leaves them stranded high and dry on the shore.

The old houses which line the main street of Roscoff date back to the sixteenth and seventeenth centuries and are all built in the peculiar style of those times. The doors are low with oftentimes a small lookout or window at one side of the entrance. The object of these windows carries one back to the times of the corsaires, when the prudent inhabitant was obliged to have some means of observation before he opened the door and allowed a visitor to enter his home. The windows are placed high upon the roofs and are ornamented with rudely-cut, grimy faces and grotesque heads of dragons. The long sloping roofs, sparsely covered with plaster, give the appearance of a recent snow storm. The houses are built of granite much eroded and with their walls often whitened by lime. With the exception of the apothecary and one or two other modern buildings none of the shops have visible signs to denote the wares which are on sale. Glass is rare in the windows and the cellars open obliquely to the pavement of the street. On the seaward side the houses are separated from the ocean by courts and gardens protected from the ravages of the ocean by high walls, which form the fortifications of the place. At intervals on the walls there are lookout towers in which, no doubt, many a time the old Breton corsaires have watched a strange vessel on the channel, or from which the wreckers perhaps have enticed a passing ship to its doom.

These houses are now the homes of the sailor and the fisherman, but in times past the smuggler found there a secure refuge from his enemies. These mysterious, small, narrow streets, leading down to the water's edge, all remind us of the trade of the smuggler and the wrecker. These men have long since disappeared from Roscoff, but the old houses, the narrow tortuous passage ways still remain and recall the history of the romantic times of the past.

On the western side of the peninsula on which Roscoff stands there is a sandy beach out of which rises in the form of a marine monster a precipice called Roch-Croum. Seaward from this cliff a number of islands much eroded project in fantastic shapes, a scarred battlement broken in points by the resistless ocean. In the forms of these rocks we can trace many a giant's head, or fancy many a monster rising out of the waves, which continually beat at their bases.

The eastern side of the peninsula is still more picturesque than the western. It forms a part of the magnificent bay of Morlaix and its cliffs rise abruptly out of the sea. Here the fortress of Taureau, a wonder of Brittany, projects out of the ocean from a submarine reef.

There is but one road leading to Roscoff from the mainland, and that bisects the peninsula entering the main street near the church. It is the national road to the neighboring city called Saint Pol. On either side there branch off true Breton lanes lined by lofty embankments thrown up by the farmers. No trees, nothing but sandy fields of onions and potatoes line its borders. Everywhere the, land swept by the high winds of the Atlantic, has a somber, melancholy look. The hills are low, and here and there rocks project through the thin covering of sand, but otherwise the landscape is little varied.

The sea, however, at Roscoff makes up the interest where the land fails to attract. Nowhere have I seen such a variety in the sky and horizon, nowhere a more savage coast resisting a more determined ocean.

There are many neighboring islands, the largest of which is called the Ile de Batz, a strange name, taken from a tongue reaching back before the origin of the modern French tongue. Near by this Island there are the so-called Bourguinous, and still further away Tisosou, "the house of the English." Some miles more distant seaward the rock of Pighet, all of which islands are remnants of a former battlement which, resisting the inroads of the sea, are fast loosing their form and size in protecting the mainland. Sown here and there are submerged rocks most fatal to navigation around which course "cailloux" or currents which render the approaches to the port so dreaded by sailors. As one glances across the channel from the island, Roscoff seems a very large city. Its sea-wall, its row of houses along the shore and the elegant church would lead one to exaggerate the size, but the town is simply a crescent of houses, enclosing fertile fields of potatoes and onions.

Such is a brief sketch of the place to which we are hastening through Brittany by way of the railroad from Paris to Brest. We alighted at Morlaix, a picturesque old town, which has contributed many a sketch to the artist's portfolio, early in the evening, and take a branch road to Roscoff. Somewhat later the train halts and we have reached our destination.

"A La Maison Blanche," says a man near me, in an accent which is immediately distinguished from that of the Parisian "cocher." "Oui!" is replied in a confident tone as if a knowledge of the whole French language was at the tongue's end. He asks if I am the American who is going to work in the laboratory and I reply that I am. We trudge down the dark road unlighted by a single lamp, and in a few moments the hostess of "La Maison Blanche" had me in charge. The hotel looks comfortable but its surroundings are very strange. The threshold of the entrance is lower than the pavement of the street. Along the entry hang rows of chickens, legs of lambs, sausages and vegetables. A crowd of Roscovites hang about the bar, which is elaborately filled with all the necessities.

The hostess has picked up a little English from the numerous sailors who frequent her house and gives me a good reception. A bed of purest white and an excellent cup of coffee and bread in the morning form a cordial introduction to a town in which I was destined to pass many, very many, happy days.

French naturalists were the first to found special institutions on the seashore for the study of marine zoology. There are many problems connected with the study of marine life which cannot be successfully taken up without a residence near the localites where the animals live, for they must be worked out either on living or fresh material, and it must be possible to have ready access to the habitats of these animals to study these questions. A first step in this work is to watch the animals in aquaria and carefully study their mode of life. With the improvement in methods of research a work room near the aquaria thus becomes a necessity for a successful answer to many problems.

One of the earliest laboratories founded especially for the study of marine life on the shore was created by Prof. Lacaze-Duthiers at Roscoff. This institution is an "Annexe" of the Sorbonne in which the founder holds a professorship of Natural History, and over the door is placed this significant inscription, so often found on public buildings in Paris, "Liberté, Egalité, Fraternité." This motto has here a new significance, and I thought as I approached the building of the well-known laboratory in Roscoff on the morning after my arrival, how much that motto means in the organization of the institution. The advantages are free to all of every nation, French, English American, Russian. Every specialist is freely given without expense the advantages of the institution. All are equal who enter its walls

with a love of nature and a desire to study, or to investigate. No one who has known its hospitality can question the justice of the third word of the legend.

The laboratory founded by Prof. Lacaze-Duthiers is a laboratory for students as well as investigators, and it numbers among its workers those who have earned the title of naturalists as well as those who have just begun their studies. It is not too much to say that every facility which experience and money can suggest are here placed without expense within reach of every student of zoology who makes a choice of Roscoff for a working place.

Everything is free, microscopes, reagents, boats manned by experienced collectors, books, work-table, instruction, all are given with a lavish hand, with no distinction of nationality or peculiarity of scientific belief. There is no charge for an opportunity to contribute to the advance of knowledge or to take the first steps in the acquisition of methods of research.

The students in the laboratory are even furnished with sleeping rooms near their working tables, so that no time may be lost or expense incurred. In liberality there is no known institution outside of France which does more or even as much for those who wish to investigate marine animals.

The laboratory at Roscoff is a laboratory for summer work and is supplemented by a second creation of the same founder at Banyuls-Sur-Mer on the Mediterranean Sea, for research in winter. These two, both connected with the University of France, offer a continuous opportunity at all times of the year for the study of marine animals of the two shores of France. They open to students two different faunas under the most experienced instructors, the most favorable influences under the most liberal circumstances.

The laboratory at Roscoff not only furnishes material for investigation, but it also presents opportunities for collecting, and for the study of marine animals in their native habitats.

In the study of marine animals on the shore, as well as in museums and laboratories situated inland, students may become closet naturalists. It is recognized that it is a good thing to collect as well as to study animals after they are collected. Two methods of work on marine animals are possible. Either the naturalist may remain at his work-table and have experienced collectors bring him what he desires to study, or he may himself visit the localities where the animals live and find them himself. Both methods have advantages,

but the latter gives a wider knowledge of the whole subject than the former, for it familiarizes one with natural conditions of the life of the animals.

The laboratory at Roscoff not only permits a study at the work-table but also offers facilities for collecting. Excursions are made to grounds where certain animals occur and in that way the possibilities of knowing more of their mode of life are increased. This feature in the marine laboratories of Prof. Lacaze-Duthiers is certainly a most important one and one which particularly commends itself to a person whose sole knowledge of animals is based on specimens preserved in a museum or brought to him by a professional collector. We may study the histology, or anatomy of an animal without knowing whether it lives in the sand or is free swimming, whether it is dredged or inhabits the shore line, but it is better to combine with that knowledge some familiarity with its natural habitat and its mode of life. One excellent feature in the Roscoff laboratory and one which attracted me to it is the fact that it offers facilities for both kinds of work.

There are two different departments in the laboratory at Roscoff, one for students who are beginners, the other for those who are investigators engaged in original research. These two departments work harmoniously and the advantages are equal for both.

The apparatus of a laboratory and the manner of investigation belongs to the technique of zoological work, a consideration of which would take me too far into details for this article. There are many excellent features in which this laboratory differs somewhat from those of other institutions of this kind, but in all marine laboratories with the readiness with which new methods are made public there is a surprising uniformity in technique in all marine stations. I should say that at Roscoff there is a proper regard to the relative importance of all branches of marine research, toxonomy, histology, anatomy and embryology, although perhaps the published results in the latter branch may show that it is not at present given the predominance that it has in some other similar institutions.

An excellent feature in the laboratory at Roscoff is the existence of a small local collection identified for the use of investigators and students. For the information of those engaged in the study of animals found there a card catalogue with a notice of the time of collecting the genus, locality where it is found, the time of laying

its eggs is an excellent help. Anyone describing a new species or genus is expected to deposit in the collection a single specimen to serve as a type for the good of those who may later avail themselves of the advantages of the place.

In our own marine zoological stations the existence of a catalogue stating the time when ova, embryos, or adults could be found or had been collected and where they occur in abundance, would be an excellent thing, and must in the course of time be made by competent observers.

The beach of Roscoff is one of the richest grounds for collecting marine animals which I have ever visited. The enormous tides lay bare an extent of bottom which is extensive, and betrays the home of a very large number of different genera of animals which live along the shore. Moreover the character of this life is greatly influenced by a branch of the Gulf Stream, which making its way from the main current bathes this part of Brittany and imparts to it the mild climate which it has. This same current also tempers the climate of the Scilly Islands, which lie in its direct track, so that several plants, which are limited to the shores of the Mediterranean, here flourish in a more northern latitude.

The rich fauna of the coast at Roscoff is, no doubt, more or less modified by the warm action of this branch of the Gulf Stream, still the floating life which distinguishes this great ocean current off the coast of the United States is almost wholly wanting. Now and then some straggling "Portuguese man-of-war" drifts into the channel, or some medusa, whose home is in the tropics, is captured, but these are exceptional. The wealth of floating marine life which the Gulf Stream brings even to the coast of New England is not found inshore on the coast of Brittany.

The most interesting building at Roscoff is the church, the steeple of which is to been seen from almost all sides of the city. This church, which has an appearance wholly Breton, has also a style partly Florentine, partly Spanish; for the interior, at least of many of the Breton churches, has a true Italian appearance, and the style of the exterior is characteristic.

The most curious part of the church is the steeple, which, as we approach the city from the sea, rises light and airy and seems almost to hang from the sky. On the side of its bell-tower, pointed toward England, the hereditary enemy of the Roscovite, there are two cannon, cut in stone, forming parts of the varied ornamentation of the steeple.

At the base of the tower on either side of the entrance one sees at right and left bas-reliefs ascribed to the fourteenth century, representing the Passion and Resurrection of the Savior, while above the entrance is one of the most interesting bas-reliefs of all the sculptures of Roscoff, a ship of the fifteenth or sixteenth century, carved in stone with scrupulous exactness. This ship is found on the walls of the church and on the hospital situated on the way to Saint Poll and seems to be the coat-of-arms of the city. Its bizarre shape, recalling the old ship of the corsaires is of very great archæological or, at all events, historical interest.

The church itself is surrounded by a low wall enclosing many trees. On either side of the main entrance there are two small buildings one ornamented with a bas-relief of the ancient ship; the other a small mortuary chapel. These are ossuaires which in old times served for receptacles of the dead. When the church-yard was full, these buildings received the overflow. Their little niches are now empty, but they still remain mute remnants of the manners and customs of a time not long past.

In the neighboring city of Saint Pol, however, we find the ossuaires in the cemetery still occupied by the little boxes in each of which is a human cranium, and around the altar of the church in the same place, we find similar relics of the dead. In the cemetery of Saint Pol these ossuaires are small buildings with covered shelves along which is seen a row of boxes each resembling a dove cot with a roof-shaped top. Each box has a small opening, diamond or heart-shaped, through which the skull of some old inhabitant can be seen, and each box bears the name of the dead. Around the altar of the church these boxes are arranged in a melancholy row. "It is considered an honor," said the father who showed me about, "to have the head thus preserved near the altar, an honor which only a few and those the most influential are permitted to share.

This survival of a habit of burial once widely spread in Brittany and France is archæologically very interesting, but at the present day the custom is wholly given up.

The church of Notre-Dame de Croatz-Batz with its interesting ossuaires may be called an historic monument of France and is an instructive relic of times long past, but there is another church, now in ruins at Roscoff, which also merits our attention. This is one of the few places of this distant town connected with the general history of France. Nothing now remains of this chapel but the

bare walls, a veritable ruin looking out on the main street of the place. Mary Queen of Scots landed at Roscoff on the 14th of August, 1548, on her way to espouse the Dauphin of France. Years after a chapel was dedicated to a Scottish Saint, Saint Ninien, in commemoration of this event.

Mary Stuart was but six years old when she landed at Roscoff. She remained there but a short time and then proceeded to Morlaix where she was officially received by Seigneur de Rohan. Afterwards she went to Saint Germain en Laye, where she is said to have remained until she was eighteen. Long after, when the widow of Francois II., she returned to Scotland and to the sad history which awaited her in England, the hereditary foe of the Bretons, on whose land she had set her foot in happier days long before.

The chapel which marks the event of her landing was for many years ornamented with many presents and remained a magnificent monument of her generosity. Later it fell in ruins and now after many years the Roscovites have placed on its wall a tablet that tells to the curious the event which the building of the chapel commemorates.

Not far from the chapel of Mary Stuart, there stands a house rebuilt in modern style, the interior of which is always interesting to visit. This house is separated from the chapel by a narrow street, and in it one still sees the remnant of an ancient cloister, with a beautiful garden protected from the sea by a tall wall in the form of the prow of a vessel. Once a cloister, then a place of meeting of merchants, it now remains an interesting relic of the Roscoff of the past, its sold columns and architecture recalling some old Italian palace of mediæval antiquity.

Many other interesting houses exist in the quaint old town of Roscoff. The many hiding places for bandits and smugglers, the dark cellars, narrow streets, all recall the old days when much of the enterprise of the place was turned to the plunder of passing merchantmen, or equally nefarious practices. The history of the Roscovite corsaires has yet to be written, but the story of Le Negrier still preserves something of the romance of the past. Here we read of the old hotel Terard, where the notorious Captain Le Bihan recounts his escapades. We also read of a ball of the corsaires in which all the inhabitants of the place participated.

The little port of Roscoff was the rendezvous of the corsaires who fled to its hospitable walls protected by the Ile de Batz. There

secure from English cruisers, they remained until another opportunity gave them a chance to sally forth on their marauding expeditions.

There are many other interesting old houses in Roscoff. As we follow the road to St. Pol, we pass the famous Hospital built in 1598, on the walls of which stand out the escurian of the Compte de Leon, boldly cut above the gate. More distant still the monastery of the Capuchins, in the garden of which may still be seen, the giant fig-tree, a marvel of Roscoff, and a proof of the wonderful fertility of the soil. This gigantic tree was planted long ago by Capuchin monks and still remains contributing its fruit—a tree more than two centuries old.

One should not neglect, in visiting Roscoff, to see the place called Kersaliou. Midway in the route from Roscoff to St. Pol, hidden in the trees, and approached by a by-path, is the retired house known in the country round as the Kersaliou, an interesting place where one can at the present time study the true Breton home. Our visit to Kersaliou gave us a good sight of the mode of life of the Breton farmer and his family.

The old house, Kersaliou, was evidently formerly the residence of men of more property than at present. It stands back from the road hidden in the trees, and as one approaches it from the main road to St. Pol, it has a most picturesque outlook. We pass through the gateway, an elaborate stone edifice, into a small court yard in which the poultry of the farm find their home, through the low door into the living room of the families which at present occupy the place, The room on the lower floor is certainly a study. At one end of the apartment there is a large fireplace on which the fire continually burns or smothers in the coals. On either side are seats where children sit in the recesses of the high chimney. No matches are used to light the fire, but a small pan of sulphur hangs near by and a bundle of sticks. When there is need of more fire these sticks are used, their tips dipped in the sulphur and ignited by the live coals. There is a cemented floor to the apartment, which is kitchen, dining room and sleeping room combined. On one side we notice a large cabinet, like a huge bureau with elaborately carved wooden front—it is an enormous wall cabinet with what appears to be many drawers, which are the beds, and as the house-wife pulls them out one by one, in the depths we see the whitest bed clothing. These

drawers are beds in which sleep the three generations of two families which live in this house.

A small box covered with a lid in which holes are pierced, is the cradle from which ominous cries have already issued indicative of the contents. It was time for the afternoon meal when we visited Kersaliou, and we were invited to share their repast with the hospitable family. The house-wife had already placed fourteen rough, earthen bowls on the table, and was breaking in each fragments of bread. The soup was boiling over the fire, and in a few minutes the dinner was ready. Each bowl received its share of liquid poured over the bread, and the family began their simple meal. Above the table hung a frame on which were placed wooden spoons and each one took his spoon from the common source. There was no need of knives or forks. The kind-hearted inhabitants of Kersaliou were true Bretons, conservative, religious, hospitable and industrious. Two grandmothers, two mothers, their husbands and a host of children, of whom only one little girl spoke French. All converse in the antique language of Gaul, a Celtic tongue allied to the Gaelic of Wales. We do not have to travel far from Roscoff to lose the soft, melodious French and then hear on all sides the old Breton, which is not a patois, but the original celtic language that dates into the remote past, and which no effort can eradicate from the country.

The old language is the common language of the country. French is an innovation which makes its way slowly but surely. The preaching in the cathedrals and churches is in Breton; the common people use no other language, and all localities bear names which will probably recall this tongue even when unspoken by the descendants of those who now inhabit the land.

Brittany is full of those curious stone structures antedating historic times, and called cromlechs and dolmens. Everywhere we find these druid monuments, at one time formed by circles of stones simply stuck up in the ground, by lines of huge rocks as at Carnac, or simple slabs placed on uprights. Roscoff has one of these monuments in its immediate vicinity. On the road to St. Pol near the latter place, we turn off from the main road into a field of cabbage, and not far off we find the dolmens of Roscoff, high upright rocks, upon which is placed a horizontal slab. Unfortunately one of these horizontal slabs has fallen, for a hunter for buried treasure has dug under the foundation and undermined it, but one can still study the

general character of the monument. This monument, as all the others of similar kind, is associated with the worship of the Druids, and dates back to ancient times. More of its use we do not know, but we were well repaid for our short visit. We turn back towards Roscoff from this antique structure along the road. In the distance we see the beautiful cathedral of St. Pol, but we must reserve our visit to this city to another time. The far distant sea, the Ile de Batz and the beautiful town of Roscoff stretching along the shore lies just before us, lit up by the rays of a setting sun.

The Roscovite is a Celt with traces of the Spaniard. He is industrious and frugal, always conservative and religious. He still retains the costumes of his fathers, his *gilet* with conspicuous buttons, his waist girt by a highly-colored band, his round hat with ribbons falling on his shoulders. He wears the sabots, he clings to the old language of Gaul.

The women are not beautiful, but they have fine eyes and well-preserved teeth. They also still retain the old costumes. The small white bonnet, worn at all times, is so tightly bound about the head that nothing can be seen of the hair. On the days of baptism or marriage, however, when the bonnet is taken off, a charming coiffure is seen and the beautiful hair bursts forth in all its charms from its hermetically-sealed prison. Each town in Brittany has a peculiar bonnet and that of the young maidens differs from the matrons.

If you wish to see religious faith go to Breton, to Roscoff. Modern science, modern free thought, has not yet a hold in this place. The Breton is religious by nature. Every one goes to the church and the whole population turns out *en masse* to the morning service. According to Reclus, Brittany is still pagan, but while the inhabitants do not worship the forces of nature, the rocks, the fountains, or the trees, they repeat the same prayers to God in the Christian church, which they have made for two thousand years, only addressed to a new divinity. "It is always the same religion continued from century to century without the inhabitants of the land perceiving the change in their divinities." The geographer, however, has drawn an exaggerated picture. The country has emerged from its old beliefs, but while much of the middle-age thought still clings to the religion, it moves less rapidly, more conservatively than in many other lands.

No one who visits Roscoff should fail to see the giant fig-tree. The soil of France nourishes no greater marvel of plant-life than

this wonderfully vigorous growth of the ages. This tree, situated not far from the main road in an enclosure in which it is sheltered by a high wall, yearly bears its fruit in a latitude which in America is half the year buried in the snows of Labrador. The mild climate which Roscoff owes to the Gulf Stream, gives to this land an exceptional flora, and the intelligent cultivation of the soil, has transfomed the country into a great garden for the raising of all kinds of vegetables. The potatoes, onions, beans, cauliflowers of Finisterre are well known in England, and many an English vessel is engaged in the transportation of them across the channel. The inhabitants cultivate one of the most storm-swept coasts of France, but the yearly products of their industries is inferior to no other in quality or in quantity.

Roscoff is also a shipping port for the lobster and the Palinurus, many of which are found in the restaurants of distant Paris. A huge vivier where these animals are kept before shipment has been built near the entrance to the harbor. This vivier is supplied from the waters around the place and even from the distant coast of Spain Thousands of these animals are yearly sent to the great cities of France and England from this little town.

The shrimps of Finisterre are well known far and wide and the "crevette" fisherwomen with their huge nets are often found in the pictures which artists have brought home to their Parisian studios, after their vacations in Brittany. When the tide is out these toilers of the sea take advantage of the small pools in which the shrimps are retained and fill their nets with this much-desired crustacean. The table of the hotels in Roscoff know also the periwinkles, a small gastropod which is universally eaten. The sea furnishes many a food fish which has not yet been adopted in other lands.

As the days go by all too fast and the time of our tarry in Roscoff is more and more reduced, we came to love its quaint old streets and church, its old houses and its antique walls more and more, but the summons back to Paris is imperative and we find ourselves back again at the station of the railroad to Morlaix. We bid adieu to the Maison Blanche, the Café de la Marine and the hospitable walls of the Laboratoire. We say good-bye to the naturalists who still linger there to finish their researches, with many a regret. In a few moments all are left behind, but we retain what can never be effaced from memory, a souvenir of the happiest two months of scientific study which we have ever past. May the splendid ma-

rine station at Roscoff and its enthusiastic master long continue the work which has had so much influence on French science, and may its liberality and hospitality be imitated and fostered in other lands by other people.

ON THE PERMIAN FORMATION OF TEXAS.

BY CHARLES A. WHITE.

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DURING the past ten years Prof. E. D. Cope has from time to time published descriptions and figures of vertebrate remains from Texas which he referred to the Permian,[2] although other authors have generally regarded the formation from which the fossils were obtained as of Triassic age.

A year ago Mr. W. F. Cummins, Assistant State Geologist of Texas, who had collected a large part of the vertebrate fossils just referred to, gave me a small suite of invertebrate fossils which he had collected from the same formation with the vertebrates. I found these fossils to possess so much interest that I afterward, in company with Mr. Cummins, visited the region in question and made collections from, and observations upon, the formation containing them.

Thirty-two species of invertebrates were collected, about one-half of which were readily recognized as well-known Coal-measure species, but a few of them were new, among which are two belonging to mesozoic types. It is this paleontological feature, in connection with important correlated facts, that especially excited my interest in the formation from which the fossils were obtained.

Although I have personally examined a considerable portion of the region within which this formation occurs, I am indebted to

[1] This article is an abstract from a bulletin of the Survey now in course of preparation.

[2] For his summary of North American Permian vertebrates, including this Texan fauna, together with references to the places of publication, see Trans. Am. Philos. Soc. Vol. XVI, pp. 285-288.

Mr. Cummins for a large part of the facts upon which the following description of it is based. This is especially true with regard to the extent of the area which it occupies.

In Texas this formation occupies an area, many hundred square miles in extent, which constitutes the western part of the southern extremity of the great central paleozoic region of the continent. The southern boundary of this area is not now definitely known, but it lies at least as far south as the Concho river. Its eastern boundary may be approximately designated as extending from Red river to the Colorado through Clay, Young, Shackelford, Callahan and Runnels counties; and its western border as extending from the Canadian river to the Concho through Hemphill, Wheeler, Donley, Briscoe, Motley, Dickens, Garza, Borden and Howard counties. The formation is known to extend northward far within the Indian Territory, but in this article special reference is made only to that portion of it which is found in Texas; and the description which is herein given is drawn mainly from observations made in Baylor, Archer and other contiguous counties.

This formation rests directly and conformably upon another series of strata in which a characteristic Coal-measure fauna prevails but which is not now known to include any fossils of mesozoic types, if we except the *Ammonites parkeri* of Heilprin, which he states was obtained from Carboniferous strata in Wise county.[3] Notwithstanding the mesozoic character of a part of the molluscan fauna of the upper formation, the preponderance of evidence makes it necessary to regard it as belonging to the great Carboniferous system, and as constituting an upper member of it. For these and other reasons yet to be stated I have little or no hesitancy in designating this Texan formation as Permian, as Prof. Cope has done; but I shall briefly discuss in following paragraphs the propriety of the use of that name for all of the North American strata to which it has been applied.

The Texas Permian is distinguishable in general aspect and in lithological character from the formation which underlies it and which represents at least a large part of the Coal-measure series as the latter is known in the Upper Mississippi Valley. And yet the Permian strata blend so gradually with those of the Coal-measures beneath, and with the gypsum-bearing beds, above that it is difficult to désignate a plane of demarkation in either case.

[3] Proc. Acad. Nat. Sci. Philad., Vol. XXXVI, pp. 53-55.

The strata of the Texas Permian consist of materials which are somewhat difficult to describe, but they may be stated in a general way to consist mainly of sandstones and sandy and clayey shales, which are sometimes calcareous, with a few layers of impure limestone, besides one somewhat important limestone horizon. A common characteristic of many of the layers is the presence of an abundance of small, hard, rough concretions, which usually become separated and accumulate upon weathered surfaces as the imbedding clayey material is removed by erosion. But what strongly impresses the general observer is the prevailing reddish color of the formation, which is due to the prevalence of red oxide of iron in most of its component materials. During the rainy season the waters of the streams which traverse the formation are reddened by the abundant ferruginous, clayey sediment, which they obtain by erosion.

The stratification is generally more or less regular, but in the district here especially referred to it contains comparatively few compact, evenly-bedded strata. Therefore the formation having been, in this district, only slightly disturbed since its deposition, few striking features in the landscape occur. That is, the district is a comparatively plain country, the surface of which, in the, general absence of forests, is diversified only by shallow valleys of erosion and low hills of circumdenudation, with here and there a hill or bluff of like origin which reaches a height of one or two hundred feet above the general level. From the top of these higher elevations extended views are to be obtained, which are of much advantage in the study of geological structure in that region.

Because of the slight disturbance which the Permian strata have suffered in the district referred to, and the general absence of bold escarpments, it is difficult to arrive at an accurate measurement of its thickness, but it is approximately estimated at 1,000 feet. By distant view from the hills before mentioned, a general, gentle dip to the westward of the whole formation is plainly discernable. It is from a succession of such observations of the dip, together with measurements of the thickness of exposed strata and estimates of that of the unexposed, that the foregoing estimate of the full thickness of the formation has been made.

A list of all the species of invertebrate fossils that have been discovered in the Permian of Texas is given on a following page. Prof. Cope's list of vertebrate species, already referred to, shows

that the same formation has furnished 10 species of fishes, 11 of batrachians and 33 of reptiles; 54 species in all.

The full thickness of the Coal-measure series in Texas is not yet known, its base not having been observed; but the portion that has been examined reaches an estimated thickness of 1800 feet. The strata are generally somewhat evenly bedded, and consist of bluish and gray limestones, gray and ferruginous sandstones, bluish and carbonaceous shales and clays; and several coal horizons are now known in the series there.[4] These strata have furnished at numerous localities, and in greater or less abundance, such characteristic Coal-measure invertebrates as the following: *Terebratula bovidens* Morton, *Spirifer cameratus* Morton, *Athyris subtilita* Hall, *Productus cora* d'Orb., *P. nebrascensis* Owen, *P. costatus* Sowerby, *P. semireticulatus* Martin, *Hemipronites crassus* Meek and Hayden, *Myalina subquadrata* Shumard, *Allorisma subcuneata* M. and H., *Nuculana bellistriata* Stevens, *Pleurotomaria tabulata* Conrad, *Bellerophon carbonarius* Cox, *B. percarinatus* Conrad, and *Macrocheilus ponderosus* Swallow. Many other species also have been found associated with those which have been just named, but the latter are quite sufficient to characterize the strata containing them as belonging to the Coal-measure series. No attempt has been made to subdivide the Coal-measure series of Texas into upper, middle, and lower portions as has been done in the Upper Mississippi Valley, and they are probably not capable of such a subdivision in this southern region. The Lower or Subcarboniferous portion of the system has also not been recognized in Texas.

Along the western boundary of the Texas Permian, as it has been indicated in a previous paragraph, a series of strata, about 250 feet in maximum thickness, now generally known as the "gypsum-bearing beds" and thought by many to be of Triassic age, rests conformably upon the Permian. In general aspect, in a prevailing reddish color, and in general lithological character, except in the prevalence of gypsum in many of the layers and the somewhat greater prevalence of clayey material, these overlying beds resemble the Permian strata upon which they rest. With only one known exception these gypsum bearing beds have furnished no fossils. The exception referred to is the discovery by Mr. Cummins in Hardiman county, in an upper stratum of those beds, of a thin magnesian layer containing

[4] Mr. Cummins informs me in an unpublished letter that he has distinguished no less than nine coal horizons there.

numerous casts of a species of Pleurophorus. This being a characteristic genus among Permian molluscan faunas and a prevailing form in the Permian strata beneath the gypsum bearing beds, the question is suggested whether the latter ought not to be regarded as constituting an upper portion of the Permian. If these beds are not separable from the Permian, it seems to be doubtful whether the Trias has any representation in Texas.

It will be seen from the foregoing remarks that in the part of northern Texas to which special reference has been made, there is a great conformable series of strata having a slight general dip to the westward, its base being covered from view by mesozoic and later formations. The estimated thickness of this older series, so far as it is exposed to view, is 3050 feet. The lower 1800 feet, together with an unknown thickness beneath, is referred to the Coal-measures. The next overlying 1000 feet of strata are designated as Permian; and the upper 250 feet of the series is doubtfully referred to the Trias, although as already intimated there seem to be reasons for regarding the latter beds as constituting the upper part of the Permian. Cretaceous strata rest unconformably, and with a contrary dip, upon the earlier eastern portion of this series; while upon the later western portion they rest with apparent conformity; although their real conformity there may be properly questioned because the Jura seems to be entirely wanting, and at most the Trias is only slightly developed.

As already stated, the Cretaceous strata appear to rest conformably upon the gypsum-bearing beds; and the latter beds lie quite conformably with the Permian and Coal-measures beneath, all having a westward dip. On the contrary, all the beds from the Dinosaur Sands, which are regarded as the lowermost Cretaceous formation in Texas, to the Tertiary inclusive, have an easterly dip and seem to lie unconformably with the Coal-measures and Permian. It is not certain, however, that the Carboniferous and older strata do not dip to the eastward beneath the Cretaceous strata, forming an anticlinal axis. Having thus shown the stratigraphical relation of the Texas Permian with the other formations, the following remarks will be confined to the Permian alone.

The following descriptive section of the Texas Permian is taken from Mr. Cummins' field notes, but it has been in large part verified by my own personal observation. The different members of this section, which are indicated by consecutive numbers, are not

distinctly definable from one another, but the section is presented in this form for convenience in making reference to the respective hórizons at which collections of fossils have been made.

DESCRIPTIVE SECTION OF THE PERMIAN OF TEXAS.

1. Reddish and mottled sandy clays, with occasional layers of sandstone.

2. Variously colored clayey and sandy concretionary strata, with a few irregular layers of impure concretionary limestone; embracing near its middle a somewhat persistent stratum of limestone of greyish blue color.

3. Sandstones alternating with clayey and sandy concretionary layers and a few fine grained silicious layers.

4. Reddish and buff colored clayey and sandy shales with occasional layers of sandstone.

5. Sandstones and sandy shales; with beds of reddish sandy clay: passing gradually into the Coal-measures beneath.

Vertebrate remains, which Prof. Cope confidently refers to the Permian, occur at numerous localities and at many horizons from the base to the top of this section; but invertebrate remains have hitherto been discovered only in strata which are included in Nos. 2 and 3 respectively of that section. The lowermost known horizon of invertebrates is about 400 feet above the base of the series, and the uppermost is about as much below the top of the same. That is, the invertebrate fossils described and figured in this article come from the middle 200 feet in thickness of the Permian series as it has just been defined.

The localities at which these fossils were obtained, only three in number, are in Baylor and Archer counties; and as the country is still an unsettled one, they can be designated only in an indefinite way. The first of these localities, which is in the northwestern corner of Archer county, will be designated as "Camp Creek." The second is in Baylor county, near the middle of its eastern boundary line, and will be designated as "Godwin Creek." The third is in the northeastern part of Baylor county, near where the old military road, constructed by General Van Dorn, crossed the Big Wichita river. This locality will be briefly designated as the "Military crossing of the Big Wichita." The strata of the two first mentioned localities occur in No. 3 of the foregoing descriptive section of the Permian, and the last named one, in No. 2.

The following is a list of all the invertebrate species which are now known to have been found in the Texas Permian, all of which are discussed on following pages. The list is presented in tabular form for the purpose of giving a synoptical view of the fauna, so far as it is at present known, and also to indicate the localities at which the respective species have been discovered, as well as their inter-association there. As to the latter condition, it is proper to state that specimens of all the species found at the locality which is indicated as the Military Crossing, were collected by myself from a single stratum, where they were found commingled in such a manner as to leave no doubt as to their having been all members of one and the same contemporaneous fauna. Specimens of the greater part of the other species were also collected by me at the localities indicated.

LIST OF SPECIES.

	Camp Creek.	Godwin Creek.	Military Crossing.
1. Goniatites baylorensis n. s.			X
2. Ptychites cumminsi n. s.			X
3. Medlicottia copei n. s.			X
4. Popanoceras walcotti n. s.			X
5. Orthoceras rushensis McChesney ?			X
6. Nautilus winslowi Meek and Worthen			X
7. N. occidentalis Swallow.			X
8. N.——— ?			X
9. N.——— ?		X	
10. N.——— ?			X
11. N. (Endolobus)——— ?			X
12. Naticopsis remex White		X	X
13. N. shumardi McChesney ?		X	
14. Euomphalus subquadratus M & W.			X
15. E——— ?			X
16. Murchisonia ——— ?		X	X
17. Patella ——— ?		X	
18. Bellerophon crassus M & W.		X	X
19. B. montfortianus Norwood & Pratten		X	
20. B——— ?			X
21. Sedgwickia topekaensis Shumard sp		X	
22. Pleurophorus ——— ?		X	
23. Clidophorus occidentalis Geinitz		X	
24. Yoldia subscitula Meek & Hayden		X	
25. Myalina permiana Swallow	X	X	X
26. M. aviculoides M & H		X	
27. M. perattenuata M & H	X	X	X

28. Gervillia longa Geinitz....		X	
29. Aviculopecten occidentalis Shumard........			X
30. Syringopora————?	X	X	
31. Spirorbis—— ——?......................... ..			X
32. Cythere nebrascensis Geinitz......................			X

SUMMARY.

Mollusca.	Cephalopoda........	11	species.
	Gastropoda.........	9	"
	Conchifera..........	9	"
Articulata,	Vermes.............	1	"
	Crustacea...........	1	"
Radiata....	Polypi..............	1	"
	Total,	32	"

By reference to the foregoing list of species, and especially to the summary at the foot of the list, it will be seen that the invertebrate collections which have hitherto been made from the Permian formation of Texas, do not represent a fauna in its usual proportions, as regards the classes and families to which the species respectively belong. This is especially true when we compare these collections with Permian faunas already known in other regions. For example, it will be seen that the Cephalopoda are in unusually large proportion, that the Brachiopoda and Polyzoa are absent, and that the Polypi are represented by only a single species. In short, it is plain that the invertebrate fauna which existed during the period in which the Texas Permian was deposited, and in the same, or in contiguous waters, is imperfectly and disproportionately represented by these collections.

Some of the causes of the imperfection and disproportion referred to, are too plainly apparent to need extended comment, and others are suggested by the lithological and stratigraphical character of the formation in which the remains are found. Besides the inevitable causes of imperfect representation of extinct faunas by their remains, a conspicuous reason for the imperfection of these collections is that the formation has yet been carefully examined in only a small part of the large region which it is known to occupy, and an exhaustive search for invertebrate fossils has yet been made at only a few of the localities which have been visited by competent collectors.

Again, there are few strata entering into the composition of the Texas Permian where it has been examined, the character of which indicates that they successively formed the bottom of waters where at least a large proportion of then existing invertebrates

could not have found a congenial habitat. That is, sandy and other silicious strata, as has already been shown, prevail in this formation, while calcareous strata are comparatively rare. It is true that certain families, especially of the Mollusca, find a silicious, sandy bottom, such as the material of most of those strata doubtless formed, more congenial than a muddy or calcareous one; but to far the greater part of all invertebrate faunas the latter kind of bottom, other conditions being favorable, is much more congenial. In short the lithological character of a formation often presents obvious reasons not only for the comparative paucity of all invertebrate fossils in its strata, but even for the absence of representatives of certain families which we have every reason to suppose existed when they were deposited, but in other, not far distant places, and in more congenial waters.

But these collections, imperfect as they are, present subjects for consideration which are of far greater interest than that which attaches to a mere addition to our knowledge of a few of the forms which constituted the fauna of any given epoch or period. Such, for example, as the relation which the fauna of one period in a given region bore to faunas which were presumably contemporaneous with it, and to those of the periods which immediately preceeded and followed it; and the indication which these fossils give as to the geological age of the strata containing them.

Three of the Cephalopod species, the names of which are given in the foregoing list, are represented on the accompanying plate, and brief descriptions of them follow.

Ptychites cumminsi n. s. Plate I figs. 4, 5, 6, 7 and 8.

Shell compressed-subglobose, volutions deeply embracing, umbilici small; septa numerous and complex, the suture line as represented by fig. 8.

Medlicottia copei n. s. Plate I, figs. 1, 2 and 3.

Shell thinly discoid, periphery narrow, medially grooved, umbilici small; volutions deeply embracing; septal suture as shown by fig. 3.

Popanoceras walcotti n. s. Plate I, figs. 9, 10 and 11.

Shell discoid; periphery deeply embracing; umbilici minute; surface marked by slightly sinuous radiating lines or indefinite ridges; septal suture as shown by fig. 11

The other species which is definitely recognized as new is a *Goniatites* whose general character is not unlike that of known Carbon-

iferous species. The *Ptychites* and *Popanoceras* may be properly regarded as of mesozoic type, such as might be expected to occur in Triassic strata. The *Medlicottia* is the first species of the genus to be discovered on this continent, and has been usually regarded as indicating the later Carboniferous, or Permian age, of the strata containing the genus.

EXPLANATION OF PLATE I.

MEDLICOTTIA COPEI.

Fig. 1. Lateral view.
" 2. Outline showing transverse section of volutions.
" 3. Suture line.

PTYCHITES CUMMINSI.

" 4. Lateral view of a small example.
" 5. Peripheral view of the same.
" 6. Lateral view of a larger example.
" 7. View of a septum of a larger example.
" 8. Suture line of the same.

POPANOCERAS WALCOTTI.

" 9. Lateral view of a small example.
" 10. Peripheral view of the same.
" 11. Suture line.

All the figures are a little less than natural size.

It will be seen from the foregoing descriptions and notes, that of the 32 species of invertebrates which are represented in the collections from the Texas Permian, only four of them are recognized as new, all of which are cephalopods, and all belong to the Ammonoidea. The others have either been previously described and published, or their specific identity with published forms is in doubt because of their imperfection, either of the specimens in hand, or of the manner of publication of the species which they probably represent. Fifteen of these Texan species are satisfactorily recognized as having been previously published, a part of which have been by some authors referred to the Permian, but the Coal-measure age of the remainder has never been questioned. Some authors also assert that not only all of the fifteen species just mentioned, but all North American invertebrate species which have ever been referred to the Permian, are really members of the fauna which characterizes the Coal-measure period. Indeed, so generally has this view prevailed during the last twenty years, that if the four new cephalopods before mentioned were not present in the Texan

collections, no American paloæntologist who is familiar with the Coal-measure fauna, would probably have hesitated to refer them all to that period.

It is doubtless true that because so large a proportion of the invertebrate species, which have been obtained from reputed Permian strata in North America, occur also in characteristic Coal-measure strata, no satisfactory separation of them into two groups has hitherto been practicable upon the evidence of invertebrate fossils; and stratigraphical evidence has hitherto been unsatisfactory also. The collections, however, which are represented by the foregoing list and descriptions, although consisting mainly of Carboniferous forms, contain at least two types which are so generally regarded as indicating the Mesozoic age of the strata containing them, that if they alone, and without any statement of correlated facts, had been submitted to any paleontologist, he would not have been warranted in referring them to an earlier period than the Trias, if he had followed the usually accepted standard of reference. These two forms have been described on preceding pages, under the names of *Ptychites cumminsi* and *Popanoceras walcotti* respectively; and with the exception of the *Ammonites Parkeri*[5] of Heilprin, also from Texas, similar types have never been found associated with recognized Carboniferous species in North America.

This, however, is by no means the first, nor the most important discovery of the commingling of Mesozoic and Paleozoic types in such a manner as to indicate that they all lived contemporaneously, and were members of one and the same fauna. The remarkable discovery by Professor Waagen, in India, of[6] many molluscan species belonging to mesozoic types associated with a characteristic Carboniferous fauna is well known. It is also well known that mesozoic characters are recognizable among certain of the Carboniferous and Permian cephalopods of Russia and Armenia, as well as of certain parts of Europe.

The special interest which these Texan collections possess lies, first, in the presence of the two cephalopods of mesozoic type as members of an invertebrate fauna composed otherwise of paleozoic types; and second, in the association of this invertebrate fauna with a vertebrate fauna composed mainly of Permian types, as de-

[5] Proc. Acad. Nat. Sci. Phila. 1884, vol. XXXVI, p. 53.

[6] See Paleontologia Indica Series XIII; Salt Range Fossils.

termined by Professor Cope, and in the known superposition of the formation containing these faunas upon characteristic Coal-measure strata. The first point of interest relates to the interdelimitation of the Mesozoic and Paleozoic; and the second, to the assumed Permian age of the Texan formation from which the collections referred to were made.

The biological interdelimitation of the Mesozoic and Palæozoic ages in geological history has long been regarded as clearly recognizable in all parts of the world. While it was well known that a considerable number of generic forms, especially of the invertebrates, respectively occur in strata of both ages, palæontologists have generally regarded it as a fundamental fact that certain orders, families, and even genera, which possess certain characteristics of structure and form, were rigidly confined to each age respectively. That is, they believed that the types which fall into the one category all ceased to exist at the close of the Palæozoic age, and that no member of the other category began its existence before the opening of the Mesozoic age. The presence of remains belonging to either the one or the other of these categories was therefore regarded as affording unquestionable proof of the geological age of the strata containing them. Attempts were made to explain the first discoveries of the commingling of earlier and later types in one and the same stratum, by assuming that the specimens showing the earlier types of structure were derived in an already fossil condition from pre-existing strata in the process of their destruction by which the materials for new strata were produced.

However unphilosophical those views concerning the chronological restriction of certain types may appear in the light of modern biology, it is not to be denied that until within comparatively few years paleontological observations in the field seemed, as a rule, to favor them. These later discoveries, important instances of which have been referred to, show conclusively that animals belonging to both the categories which have just been indicated lived contemporaneously. It furthermore appears that some of those which have been regarded as exclusively mesozoic in character began their existence while yet Palæozoic forms were far in the ascendant; and also that many Palæozoic types survived their earlier associates and lived in association with Mesozoic faunas. As I shall discuss this subject in another publication, it need not receive further consideration here; but I offer in following paragraphs some general re-

marks upon the reputed North American Permian, in the course of which reference will be made to the bearing which the presence of Mesozoic types among the Texan Permian fossils has upon the question of the geological age of the strata containing them.

From time to time during the past thirty years there have been discussions among geologists as to whether there is in North America any true equivalent of the Permian formation of Europe. Some writers have been uncompromising in their advocacy of the affirmative side of this question, and others have been equally positive in asserting the negative. Much of this difference of opinion has arisen from imperfect knowledge of essential facts, and much from want of a clear definition by the respective writers as to what they have regarded as constituting equivalency in this case. Although much addition has within the past few years been made to our knowledge of facts bearing upon this question, and it is evident that clearer views upon it are now generally held than formerly prevailed, it is too much to expect that the views of all geologists should even now fully agree. The following statement of the present condition of this question, as the writer understands it, is presented that the reader may understand more clearly his views, and the reasons for the conclusions and opinions which are expressed in this article.

In Europe the Carboniferous system is understood to be divided into three great groups, namely, the Lower Carboniferous, the Coal-measures and the Permian, which are definable from one another, not only by palæontological, but by stratigraphical characteristics. In North America, the great Carboniferous system is quite as largely developed as in Europe. The Lower Carboniferous and Coal-measure groups are, upon both stratigraphical and palæontological grounds, as clearly recognizable and distinguishable from each other, in some parts of this continent, as they are in Europe, but the Permian has hitherto had no such undisputed recognition. Therefore, the question now to be considered is whether the Permian of Europe has really an equivalent anywhere in North America; and if so, how that equivalency is recognizable.

There are seven principal regions in North America within which strata occur that have been by different authors referred to the Permian. These are (1) southwestern Pennsylvania and northern West Virginia; (2) Prince Edwards Island; (3) eastern Illinois;

(4) northeastern Kansas and southeastern Nebraska; (5) South Park, Colorado; (6) isolated portions of New Mexico, Arizona, Utah and Western Colorado, and (7) northern Texas and the adjacent part of Indian Territory.

In all these cases there seems to be no room for doubt that the strata in question are not older than the Upper Coal-measures, as that formation is distinguishable in North America, but aside from their evidently high position in the Carboniferous system, their recognition as Permian has been based upon different kinds of evidence in each case. In the first and second mentioned cases it was based wholly upon plant remains; in the third, upon vertebrate remains alone; in the fourth, upon invertebrate remains; in the fifth, upon plants and insects,[7] and in the sixth, mainly upon stratigraphical position. The evidence in favor of the recognition of the strata, as constituting a separate formation in the seventh case, is presented in this article.

Two general ideas seem to have prevailed respectively in the minds of those who have considered the question of the recognition of the Permian in North America. On the one hand, the discovery on this continent of remains belonging to generic or other types of vertebrate, invertebrate, or plant life, which are respectively similar to forms found in the European Permian, have been regarded by some authors as surely indicating in each separate case the Permian age of the strata containing them, even in the absence of, or without regard to, correlated facts, whether paleontological or stratigraphical. On the other hand, it has been contended that no definite recognition of the Permian, even in the first-mentioned cases, ought to be made until after due consideration of all obtainable correlated palæontological and stratigraphical facts; and not then, unless the preponderance of all that evidence should plainly favor such recognition.

The untenableness of the position indicated in the case first stated is shown by the facts mentioned in preceeding paragraphs of the occurrence in one and the same stratum of forms which have been held to be characteristic of separate geological periods, and even of separate ages. It is conspicuously shown in the case of the Texan formation, which is specially discussed in this article, be-

[7] These insects, however, have been by Scudder referred to the Trias, although they are associated with the most characteristic Permian flora that has yet been discovered on this continent.

cause both its Coal-measure and Triassic age can be even more readily proved, in an ex parte way, by special selections from its fossils, than its Permian age. And yet the sum of all the evidence is in favor of the latter.

The following paragraph from the work of Professors Wm. M. Fontaine and I. C. White tersely states[8] the principle which ought to govern the investigator in these cases, although it was written only with reference to the Permian character of the flora which they were then investigating.

"It is good evidence that we have to deal with a more recent formation, when we find it to show a decadence of old forms, and an introduction of new ones, destined to reach their culmination at a later period. Thus if we find, in a series of rocks, plants characteristic of the Carboniferous formation, and perceive that these die out and disappear, we should not conclude from their mere presence that the age of the strata is Carboniferous, but rather that it is Permian. So also the finding of genera and species, even identical with those of the Trias or Jurassic, would not necessarily imply a Triassic or Jurassic age. If we find them to be exceedingly rare, their presence is rather indicative of a formation older than the Trias or the Jurassic. It is only by taking into consideration all the above named characters and other points which may be presented by the entire body of specimens, that we can determine the nature of the evidence offered by the life of a formation. It will not suffice to say arbitrarily that this or that feature is without value as evidence. Circumstances might reverse the normal relative weight of evidence from the several sources, and give preponderating weight to what would, if unaffected by them, have slight value."

Besides the observance of this principle, the investigator should remember the entire improbability that distinguishing types could have been simultaneously introduced in all parts of the world; and the no less evident fact that certain types in different parts of the world long survived their extinction in other parts. He should also bear in mind the now evident fact that the rate of progressive development of vertebrate, invertebrate and plant life respectively has not been uniform in all parts of the world. It therefore ought not to be expected that precisely the same associa-

[8] "Permian or Upper Carb. Flora of West Virginia and S. W. Pennsylvania. Second Geol. Surv. Penn. Rep. Prog. P. P., pp. 109, 110.

tion of types would be found on this continent that occur in Europe and elsewhere.

Much difference of opinion has prevailed even among those who recognize the importance of considering all the facts which bear upon a given case of assumed equivalency. Some have believed that it should be strictly chronological as regards the whole of a given formation; while others claim that the most we can reasonably assume in any case is approximate contemporaneity, and all that we can ever certainly know in such cases is the homotaxial relations of formations in different parts of the world respectively. The scope of this article, however, will admit of only a partial discussion of those views.

If all the time which is represented by the entire Carboniferous system in Europe is represented by the entire Carboniferous system of North America, the Permian of Europe must necessarily have a complete time equivalent somewhere on this continent If that system is everywhere incomplete at the upper limit on this continent, and the same is complete in Europe, it necessarily follows that the stratigraphical time equivalent of the European Permian is either absent or incomplete in North America. But all the known facts which bear upon this case are of such doubtful value in their application to the question of strict chronological equivalency that it seems to be unprofitable to discuss it. Therefore the only question that remains to be considered in this connection is that of homotaxy.

The question, even after being reduced to these limits, is a complex one, for it still involves the consideration of conflicting and disagreeing palæontological evidence as well as a recognition of upper and lower delimiting boundaries of the formation. There can be no good reason for doubting that there are in various parts of North America strata which are homotaxially equivalent, at least in part, with the Permian of Europe. But it is equally true that much of the reputed North American Permian cannot be satisfactorily separated from the Coal-measures, and even those which have been separated more or less satisfactorily, are found to be so intimately related to the Coal-measures as to make the lower limit indefinable.[9]

[9] In view of the last mentioned condition, several American and European writers have applied the compromising term "Permo-Carboniferous" to that undefinable upper portion of the Carboniferous system. Unfortunately, however, some American authors have of late applied the same term to the whole Carbonif-

Heretofore it has been impracticable to say whether the upper limit of the Carboniferous system in North America is complete or not. For example, none of the reputed Triassic strata, which occur in various parts of the continent, have been found in such relation to the reputed Permian as to indicate that there was continuous sedimentation from the one formation to the other; nor have those Triassic strata been found to contain any conclusive palæontological evidence of their immediate succession to the Permian. Indeed, as regards the remains of invertebrate life, the existence of any Triassic strata in North America rests upon comparatively slight evidence: slighter, indeed, than it might have seemed to be before the discovery of Triassic types associated with well-known Carboniferous forms.[10]

The conflicting character of a part of the evidence afforded by the reputed North American Permian as to its age has already been shown, but there is an important case of want of harmony of different portions of certain accepted paleontological evidence that deserves mention. In Professor Cope's systematic catalogue of the Permian vertebrate fauna of North America,[11] he shows that it has been discovered mainly in two limited districts, one in eastern Illinois and the other in Texas. His catalogue also shows that of the 76 species enumerated, not one, and of the 32 genera only five, are common to the two districts. He also states that "the Permian vertebrate fauna of Illinois and Texas exhibits close parallels, but not yet generic identity on this continent."[1]

On the contrary, the marine invertebrates which characterize the North American Coal-measures, a part of which usually range up into the reputed Permian, are widely distributed on this continent,

erous series; seeming thereby to imply that the series includes an inseparable equivalent of the Permian, as well as the remainder of the system.

[10] The Triassic character of a part of the Permian fauna of Texas has been sufficiently stated, but it is also true that certain Carboniferous types occur in the Meekoceras beds of southeastern Idaho. Besides this, those beds appear to have an intimate stratigraphical relation with the characteristic Carboniferous strata beneath them. Add to these facts the further one that types similar to those which have been relied upon in referring the Idaho beds to the middle Trias, also occur in undisputed Carboniferous strata, and it seems possible that those reputed Triassic beds ought to be referred to the Permian rather than to the Trias.

[11] Trans. Am. Philos. Soc. vol. XVI, pp. 285-288.

[12] See Vol. III., Book I, U. S. Geol. Surv. Terr., p 25.

and their geographical range includes both the Illinois and Texan vertebrate localities. That is, the invertebrate fauna referred to is uniform over a region in which the vertebrate fauna is diverse.

In all the vertical and geographical range of these invertebrate fossils, there has never been observed any evidence of the decadence of old forms[13] such as would be taken to indicate an approaching close to the geological period which they have especially characterized; and it is only in the case of the Texan Permian that an introduction of new forms has been yet observed which might be regarded as forerunners of a new one.

Finally, while it is freely admitted that a considerable number of the invertebrate species which characterize the Permian of Europe have nearly related representatives on this continent, it should not be forgotten that they are as characteristic of our undisputed Coal-measures as of the reputed Permian. Even if those forms are really specifically identical on the two continents it does not necessarily prove the contemporaneity of the respective formations containing them. In fact those formations must be necessarily of a difference in age equal to the time required by the distribution of the species.

The recognition of the Permian of Texas as a separate upper group of strata belonging to the Carboniferous system is based upon both stratigraphical and palæontological evidence, and this evidence is fuller than that which has been adduced in favor of any other reputed Permian strata of North America. First, it contains invertebrate species which have been referred to the Permian in other districts to the northward, some of which are closely related to Permian species of Europe. Second, it contains the large vertebrate fauna published by Professor Cope, which he regards as characteristically Permian. Third, the Texan formation evidently constitutes an upper, apparently the uppermost, portion of the Carboniferous system. Fourth, the lithological difference between this formation as a whole and the Coal-measures beneath it

[13] It has been pointed out by some authors that certain of the brachiopods and other species which characterize the Coal-measures, have never been found in any of rhe reputed Permian strata, and it seems to have been assumed that their absence was due to a final decadence of those forms before the Permian period was reached. It seems, however, not at all unreasonable to infer that successive changes of conditions differently affected different classes of animals, in consequence of which the forms referred to were not extinguished, but only differently dispersed.

is sufficiently marked to make it conveniently distinguishable by the eye. Besides this, the mesozoic element which has been shown to exist among the invertebrates of the Permian of Texas may be properly regarded as holding an opposite relation to the Palæozoic element, and thus to suggest a balance of palæontological evidence in favor of the Permian age of that formation.[14]

The present state of our knowledge, or warranted opinion, as to the existence of the Permian formation in North America may be summed up briefly as follows :—

Although the two earlier groups of the Carboniferous system, namely, the Lower Carboniferous and Coal-measures are as clearly recognizable in the region traversed by the Mississippi river as they are in Europe, in many parts of this continent where Carboniferous strata are largely developed no distinctive recognition of either of those groups, or of the Permian, is practicable.

In those regions where the Coal-measures or their equivalent strata are recognizable, certain strata are sometimes found resting upon them which have been referred to the Permian; but those strata are as a rule, not distinctly separable from the Coal-measures upon either stratigraphical, or palæontological ground. That is, no distinct stratigraphical plane of demarkation between the Coal-measures and the reputed Permian is observable. Besides this, many of the common Coal-measure species range up into those Permian strata, and many acknowledged Permian types, according to the European standard, occur in the unquestioned Coal-measure strata beneath them.

The upper limit of the Carboniferous system and the lower limit of the Trias, have never been clearly recognized upon this continent, and it is therefore not yet known that either of these systems are here at any point complete in that respect. But the upper limit of the Carboniferous system is known to be incomplete at most places where strata of that age occur.

Notwithstanding the mezozoic character of some of the fossils found in the reputed or true Permian strata the relationship of all these strata, both palæontologically and stratigraphically, is far more intimate with the Carboniferous than with the Trias.

14. The value of this suggestion is somewhat lessened by the known presence of the *Ammonites parkeri* of Heilprin in the underlying Texan Coal-measures, and by the presence of similar types beneath the Permian in certain parts of the old world. Still, such forms as *Ptychites cumminsi* may properly be regarded as mmediate harbingers of the Mesozoic age.

A large part of the North American strata which have been by various authors referred to the Permian have no valid claim to be either so considered, or as being separate from the upper Coal-measures. But a part of them may be reasonably assumed to be homotaxially equivalent with at least a part of the European Permian; although their delimitation from the Coal-measures may in most cases be difficult or impracticable.

The evidence upon which the Texan strata have been referred to the Permian is fuller than that which has been adduced with regard to any other North American strata, that have been so referred. That is, the evidence of both vertebrate and invertebrate fossils is in favor of such reference, and the difference in the character of the strata from those of the underlying Coal-measures, although not great, is conveniently distinguishable. Still, it is true that the Texan Permian strata bear many Coal-measure invertebrate species; and its flora is at present unknown.

ON THE MAMMALIA OBTAINED BY THE NATURALIST EXPLORING EXPEDITION TO SOUTHERN BRAZIL.

BY E. D. COPE.

THE Naturalist Exploring Expedition left New York for Southern Brazil in the year 1882, and landed at Porto Alegre in the department of Rio Grande do Sul, with the object of making collections in that province.[1] It was under direction of Herbert H. Smith, whose former service under Prof. Frederick Hartt in the Geological Survey of Brazil, had given him ample acquaintance with the people and language. Regular collections were first made at the village of Sao Joao do Monte Negro, on a tributary of the Ura-

[1] Articles descriptive of this region by Mr. H. H. Smith will be found in the AMERICAN NATURALIST, 1883, pp. 480, 707 & 1007.

guay River, in the western centre of the province, in about lat. 28° south. After a residence there of several months, Mr. Smith and party proceeded north-west to the interior province of Matto Grosso, ascending the Paraguay River to Cuyaba. From Cuyaba the party went about thirty miles to the north-eastward, to the little village of Chapada, where they remained for months. This locality was especially favorable for the objects of the expedition, being on the boundary line between the great plains to the south and the forest-covered mountains on the north, and at the heads of the drainage of the Paraguay to the south, and of the Xingu tributary of the Amazon on the north, at about lat. 15° S.

The difference in the characteristics of these localities is easily observable in the collections obtained from them. I have already published reports on the Batrachia and Reptilia from both localities,[1] and the present report embraces the Mammalia. The insects and birds are in the Museum of Natural History, Central Park, New York. Researches on the Mammalia of these regions have been already made by Hensel[2] and Von Jhring in Rio Grande do Sul, and by Natterer at Cuyaba. The collections of the last-named explorer are worthily described by Wagner of Munich, and a full report on them has been made by Von Pelzeln.‡ of Vienna. Sixty-five species were obtained by Mr. Smith, most of them represented by many specimens, and five of the species appear to be new to science. The distribution of these as to locality will be stated at the close of the paper.

MARSUPIALIA.

1. DIDELPHYS MARSUPIALIS AZARÆ Temm. (Thos.)

Two skins with skeletons from Sao Joao; three skins with skeletons from Chapada; one skin with skull from Sao Joao; two skins from Chapada, two from Sao Joao, and four without locality; also one skeleton from Chapada, two skulls from do, three skulls from Sao Joao, and two skulls and a skeleton of unknown localities.

2. DIDELPHYS MARSUPIALIS AURITA Wied. (Thomas).

One skin from uncertain locality. Although fully grown, the long dorsal hairs and the ears are perfectly black, and there are large spots above the eyes. Belly light brown.

[1] Proceedings American Philosophical Society, 1884, p. 185; 1887, p. 44.

[2] Memoirs of the Akad. Wissensch. Berlin 1872. ‡ Zoolog. Botan. Gesselsch. Wien, 1883.

3. PHILANDER PUSILLUS Desm.

A specimen in alcohol, and a skeleton, probably of this species, from Chapada.

The generic name Philander is used here for the opposums without marsupial pouch, without regard to other characters.

4. CHIRONECTES MEMINA Cuv.

One skin with skeleton from Chapada.

CHIROPTERA.

PHYLLOSTOMIDÆ.

5. PHYLLOSTOMA HASTATUM Pallas.

Chapada.

6. CAROLLIA BREVICAUDA Weid.

Chapada.

7. ARTIBEUS PLANIROSTRIS [1] Spix.

Chapada.

8. ARTIBEUS BILOBATUS Peters.

Neither of the two specimens from Chapada agree with the description given by Professor Peters in all respects. The edge of the lancet of the nose-leaf is not crenulate, and the border of the horseshoe is but slightly lobed. In all other respects the specimens agree with the descriptions. The degree of the lobing of the edge of the

[1] DERMANURA EVA sp. nov.

Founded on two adult males from the Island of Saint Martins, West Indies.

Dentition, I.$\frac{2}{2}$; c.$\frac{1}{1}$; pm.$\frac{2}{2}$; m.$\frac{2}{2}$. Median upper incisors emarginate; all the inferior incisors emarginate. Lip tubercles as usual in this genus and Artibeus, those of the permaxillary region narrow and separated by vertical plicæ, and without an interior row of rounded warts as in *A. planirostris*. Inferior border of horseshoe free and not appressed, its lateral borders once undulate. Ear laid forwards reaching to middle of eye. Tragus acuminate, widest at the middle, triangular in section, the edge external. Interfemoral membrane notched to a line opposite to the middle of the tibia. Hind legs and feet, interfemoral membrane to line of knees, and proximal half of fore-arm, with a sparse silky fur. Wing membrane furred to middle of femur above and below. General color brown, reddish tinged on the limbs and head. Sides of head a pale shade, above each eye to inner side of ear, paler.

Length of head and body, m. .079; of interfemoral membrane to notch, .012. Length of head .032; of leaf of muzzle, .0125; of fore-arm, .059; of tibia, 021; of posterior foot, .017.

According to Dobson, this species approaches nearest to the *D. quadrivittata*, but it differs in its much superior size and in the different form of the external incisor tooth. It is as large as the *Artibeus planirostris*. Dr. R. E. Van Rijgersma.

horse-shoe may be variable; and I observe some crenation of the edge of the same in some specimens of the *Vampyrops lineatus* which is wanting in other specimens.

9. VAMPYROPS LINEATUS Geoffroy.
Chapada.

10. STURNIRA LILIUM Geoffroy.
Chapada.

EMBALLONURIDÆ.

11. MOLOSSUS RUFUS Geoffr.
One specimen from Sao Joao.

12 NYCTINOMUS BRASILIENSIS Is. Geoffr.
Four specimens from Sao Joao.

VESPERTILIONIDÆ.

13. VESPERUS ARGE sp. nov.

Dentition I. $\frac{2}{3}$; c. $\frac{1}{1}$; Pm. $\frac{1}{2}$; m. $\frac{3}{3}$. Inferior incisors trilobate, placed transversely to the mandible; superior incisors unequal, the external simple, narrow, not quite so long as either lobe of the internal, and placed close to it and to the canine. "First" (second) inferior premolar much smaller than second, and in line with the latter. Ears much shorter than the head, when laid forwards reaching a short distance in front of eye, near the apex. Helix openly notched on the external margin, which is thus turned outwards and obtusely rounded. Tragus convex, separated from helix by a very open emagination. Antitragus elongate lanceolate, with the greatest width near the middle, and with a rounded lobe at the external base. Lateral swellings of the muzzle large, covered with sparse hair. At their anterior extremity and just above the nostril is a deep fossa which is connected by a groove with the nostril, giving the appearance when closed of an oblique slit-like nostril, as in *V. platyrhinus* of Dobson. No tubercles on the soles. Interfemoral membrane inclosing all the caudal vertebræ, which terminate in a short free catilaginous apex. Wing membrane to base of hallux. Calcaneum long; postacalcaneal lobe distinct, narrow. Tibia elongate. Fur extending on the wing membranes by a narrow border only above and below, not extending on interfemoral membrane. Antebrachial membrane not reaching middle of fore-arm.

Color above dark brown tinged with reddish; below similar, the hairs with lighter brown tips. Inferior side of interfemoral mem-

brane pale or milky, the color becoming less decided towards the margins.

Length of head and body m. .061; of tail .038; of head .020; of hind foot, .010; of third digit, .071.

One[1] from Sao Joao.

EDENTATA.

MYRMECOPHAGIDÆ.

14. MYRMECOPHAGA JUBATA Linn.

Four skins with skeletons, and three skulls, from Chapada.

15. MYRMECOPHAGA BIVITTATA Desm.

Two skins with skeletons, and two skeletons and a skull from Chapada ; one fresh skin purchased at Sao Joao.

16. MYRMECOPHAGA BIVITATTA STRAMINEA sp. nov.

This species is represented by a nearly perfect skin in good preservation. Its proportions are much as in the *M. bivittata*, including the relative length of the tail. The internal claws are smaller than in the common species. The most obvious peculiarity is the color. This is a general straw-color, uninterrupted excepting by two black bands on the shoulders, and a black patch on the middle of the abdomen. The black bands commence immediately in front of the shoulders, and extend posteriorly over them, and terminate above a point about an inch posterior to the axillæ, converging very slightly, or nearly parallel. A blackish band passes from the eye, which it surrounds, to the muzzle. Claws dark horn-color.

Measurements of skin in normal proportions.

	M.
Length to base of tail (below)	.410
" of tail	.365
" from end of muzzle to eye	.055
" " " " to ear	.095
" of ear	.028
" of fore leg	.153
" of second claw (chord)	.016
" of third claw (chord)	.037
" of hind leg	.150
" of sole of hind foot (exclusive of claws)	.069
" of posterior fourth claw	.015

[1] In a cave near Chapada, Mr. Smith found skulls of species of bats of the genera Molossus, Phyllostoma, and Chiroderma.

Burmeister (Thiere Brasiliens) refers to specimens of the *M. bivittata* in which the black of the dorsal regions is very much reduced in extent.

The type specimen is not fully grown I suspect. The label has been lost, so that I do not know whether it was obtained at Sao Joao or at Chapada.

17. MYRMECOPHAGA ?SELLATA [1] Cope.

A skin from Chapada resembles almost exactly this species or sub-species, in coloration, differing only in the non-continuation of the median yellow dorsal stripe to the yellow of the rump. But unfortunately it lacks the end of the tail so that the length of this part cannot be ascertained. I therefore refer it here with doubt.

Two specimens from French Guiana are in the Museum of the Academy of Natural Sciences in this city. They are grizzled straw-color, and have no black bands or spots. The hair of the entire superior regions is black at the base. The tail, is as long as the head and body together. These animals I suppose to belong to the *M. longicaudata* of Schreber, but the tail is not twice as long as the body

[1] MYRMECOPHAGA SELLATA sp. nov.

This species is founded on a skin which I obtained from Dr. Fritzgaertner, who brought it from Honduras and displayed it in the exhibit from that country at the World's Exposition at New Orleans. It is characterized by its long tail and peculiar coloration, exhibiting characters between the *M. longicaudata* of Wagner and the *M. bivittata*. While the tail is as long as the body in the latter, it is said to be nearly double that length in the former. In the *M. sellata* it is at least equal to the head and body together, but as the extremity is wanting it may have been longer. The hairs on the extremity of the tail are very sparse.

The color is characteristic. The ground is straw-color. An oblique black band commences on the front of the upper arm and extends upwards and backwards over the shoulder, and converges rapidly towards its fellow. They do not, however, meet, but each is continuous with a large black patch which covers the back and sides on each side of a narrow median band of the light ground-color. These patches extend posteriorly above to the end of the lumbar region, and then the boundary runs obliquely forwards on each side to the groin. This leaves the thighs, rump and tail of the pale ground color, regions which are black in the *M. bivittata*. The dusky color in front of the eye is very indistinct. The feet and end of the muzzle have been unfortunately cut off from this specimen, so that their characters cannot be ascertained. The length of the body to the base of the tail is 0.400 m.; length of tail, .515 m.

Besides the three skins above mentioned, there are two of the *M. bivittata* in the Museum of Philadelphia, one from the Magdalena River, and one from Brazil.

as Gray states, but as long as the head and body, as in the *M. sellata*, and considerably exceeding that of the *M. bivitatta*.

DASYPODIDÆ.

18. XENURUS GYMNURUS, Illiger, 1815.

Three skins, with skeletons, one from Sao Joao, and one from Chapada.

19. XENURUS HISPIDUS Burmeister.

Twelve individuals, all from Chapada: evidently abundant, and constant in its characters.

20. DASYPUS SEXCINCTUS Linn.

Two skins, five skeletons, and nine skulls, all from Chapada.

21. PRIODONTES MAXIMUS Kerr.

One individual complete, and one skull from Chapada.

22. TATUSIA PEBA Desm.

Two skins, with skeletons, from Sao Joao; one skin with skull, four skeletons and nine separate skulls, all from Chapada.

23. TATUSIA MEGALOLEPIS sp. nov.

Movable bands, six; transverse bands or rows on the scapular shield, counted near the border, and omitting the large posterior row, twelve. Transverse rows on the pelvic shield, counted near the border, twelve, without the anterior wide marginal row. Tail considerably shorter than body, cylindric to the end. No rudimental thumb on the forefoot. Ears one-third as long as head. Two short hairs issuing from each scute of the movable rings. Hair of inferior surfaces very sparse.

Measurements.

	M.
Length of carapace (axial)	.197
" of shield of head	.055
Width between orbits	.026
Length of ear	.025
" of tail	.166
" of fore leg	.052
" of third claw of fore foot (fourth)	.017
" " " hind foot	.012

The large size of the scales distinguishes the *Tatusia megalolepis* from the *T. peba* and the *T. hybrida* at all ages. The number of scuta in a movable band in the former is only 43, while in both the latter the number ranges from 57 to 60. It resembles the *T. hybrida* in the short tail,

but differs from this species in its longer ears, which are quite as in the *T. peba*, and also in the rounded and not angulate posterior border of the head shield, with one and not two rows of scales. The skull displays some slight differences from that of the *D. peba*. One character appears to be of value. The pterygoids are produced towards the median line, so that their opposing edges are parallel and separated by a fissure only, and this fissure is continued on the middle line into the palatine bone for a distance of nearly 2 mm. In all of my numerous skulls of *T. peba*, the pterygoid borders are either divergent or are separated by a wide space, and the palatines are not notched posteriorly. The palate is flat, with the borders rounded, and not recurved.

A single specimen with skeleton from Chapada.

RODENTIA.

SCIURIDÆ.

24. SCIURUS ÆSTUANS Linn.

One skin with skeleton, one with skull, and one entire skeleton, from Sao Joao.

25. SCIURUS VARIABILIS Geoff. var *Langsdorffii* Natt.

Four skins with skeletons, four skins with skulls, nine separate skins, and four separate skulls, all from Chapada.

Mr. J. A. Allen refers the *S. langsdorffii* of Natterer to this species as a color variety. All of the above seventeen skins are identical in color, showing that if it is but a variety, it is very constant in this locality. I may add that of the eleven skulls of the collection, all have but one superior premolar, and not two as given by Mr. Allen for the S. *variabilis*.

MURIDÆ.

26. CRICETUS sp.

Chapada.

27. CRICETUS sp.

Chapada.

28. CRICETUS sp.

Chapada.

29. CRICETUS sp.

Sao Joao.

[1]Report U. S. Geol. Survey Terrs. XI, p. 768.

30. MUS ALEXANDRINUS Geoffr.
Chapada. With a litter of young.

31. MUS DECUMANUS L.
Sao Joao.

ECHINOMYIDÆ.

32. DACTYLOMYS AMBLYONYX Wagner.
Three skins with skeletons, from Sao Joao.

These specimens agree with the descriptions given by Hensel and Burmeister. The dentition differs from that of the *D. typus* Geoff. as figured by Geoffroy[1] and F. Cuvier,† in having the two component V-shaped columns in both jaws united by a narrow isthmus, as is the case in the columns in Echinomys. This fusion is probably due to the age of the specimen, as it takes place on wearing in the genus Echinomys. Another character is the transverse lamina-like anterior plate of the first inferior molar (premolar), which is represented by a cylindric column in the *D. typus*, according to the authors cited. The superior molars are not nearly so close together anteriorly as is represented by St. Hilaire to be the case in the *D. typus*, and they diverge a little posteriorly.

HYSTRICIDÆ.

33. SPHINGURUS PREHENSILIS Linn.
Three skins with skeletons, and one skull, from Chapada.

34. SPHINGURUS SERICEUS sp. nov.
All the inferior surfaces with the forearm and lower leg destitute of spines, but clothed with a silky hair of which the basal half is black and the terminal half silvery white. Superior surfaces to the middle of the length of the tail, spinous; the spines concealed by long silky hair except on the head, nape, and proximal half of the tail. This hair is much longer than that on the inferior surfaces, and is similarly colored, i. e., with the basal half black, and the terminal half silvery, but more inclining to gray than on the inferior surfaces. The spines are an inch and a half long, becoming shorter on the tail, the front, and the upper lip, and are rather slender, and on the nape are decurved. Those on the interorbital and suborbital regions are still more slender. The nasal, preorbital, and subcaudal regions are

[1] Geoffroy St. Hilaire, Nouv. Ann. du Museum I, 450 pl. XVIII, fig. 3; Is. Geoffr., Magaz. de Zoologie, 1840, p. 27, pl. XXVIII, figs. 1–3. † Dents des Mammifers.

covered with rather stiff hairs, the latter becoming silky towards the end of the tail.

The spines are generally black on their basal half, and sulphur yellow on their terminal half, without other color on the apex. Those of the interorbital, suborbital and prescapular regions, are white, with a black space at the middle, and the base of the spines is also white below the black on the posterior regions of the body, and on the tail. The hairs covering the basal half of the tail below are yellow; those covering the terminal half are black. End of muzzle projecting beyond mouth, covered with minute silky hairs. Whiskers long, black.

Measurements of skin.

	M.
Total length	.665
Length from end of muzzle to vent	.395
" " " " orbit (on axis)	.020
" of fore limb	.130
" " foot on sole (total)	.045
" " claw (third)	.020
" of hind limb	.135
" " foot on sole (total)	.063
" of third hind claw	.018

Measurements of skull.

	M.
Total length on base	.073
Length to line of orbits (axial)	.022
Interorbital width	.026
Length of palate from incisors	.032
Width of palate below m. iii	.010

In the determination of this species I have had before me in the museum of the Academy of Natural Sciences, three specimens of *S. villosus* Cuv. (*S. insidiosus* Licht.), and one each of the *F. melanurus* Natt., and the *S. nychthemerus* Licht. These render it evident that the only species with which it is necessary to compare the *S. sericeus* is the *S. affinis* of Brandt, which I have not seen. That animal is described as being brown above and below, instead of silvery white, and in having the spines brown tipped. The humeral spines are exposed, which they are not in the *S. sericeus*. It is said to have a postorbital process of the malar bone. This is wanting in the *S. sericeus* (two skulls).

The *S. sericeus* was probably included by Mr. Hensel in the

S. villosus in his memoir on the Mammalia of Southern Brazil.[1] He refers to such variations of color and length of hair, as will embrace both species. Should his species not be separable from the *S. villosus*, then the *S. melanurus* and *S. nycthemerus*, must be also united with the latter.

The entire absence of all brown color from the hair and spines of this species, and their replacement by silver white and sulphur yellow, gives it a very distinct appearance.

CAVIIDÆ

35. Cœlogenys paca Linn.

One skin with skeleton from Sao Joao; one skin with skeleton from Chapada, and two skulls without locality.

36. Dasyprocta azaræ Licht.

Six skins with skeletons from Chapada; one skin with skeleton from Sao Joao; four skins with skulls from Chapada; one skin from Chapada without skull; one do, from Sao Joao; two skeletons without skins from Chapada, and one from Sao Joao; and eight skulls without skins from Chapada; total twenty-five individuals.

The single skins from Sao Joao have the inferior surfaces of a deeper yellow than those from Chapada, and the hair of the rump is less tinged with gray and more with yellow, than in the latter.

37. Dasyprocta aurea sp. nov.

This species is represented by but a single perfect skin in excellent condition, from Chapada. It is superficially most nearly related to the *D croconota* and *D prymnolopha* of Wagler, and represents them in Southern Brazil. The species is of about the size of the *D. azarae* and resembles it in general proportions. The ungues are, however, shorter, as is also the sole. In color it is peculiar. The hairs are uniform orange yellow on all parts of the body, paler at the base. There is no crest of long hair on the nape as in *D. prymnolopha*, but the hair of the rump is elongate, and rather paler in color than on other parts of the body. The top of the head is a little darker than the back, having a rufous tinge. The anterior faces of the feet are similar to the top of the head. The belly is a little paler than the back, but not so pale as the rump. Soles and claws yellowish horn color. The ears are rather sparsely haired. The tail is very short, as in the *D. azarae.*

[1] Memoirs of the Akademie der Wissenschaften of Berlin, 1872, p. 56.

In the following measurements some allowance must be made for stretching of the skin.

Measurements of skin.

	M.
Total length	.660
Length of tail	.010
" from end of muzzle to orbit	.067
" " " " to ear	.113
" " " " to axilla	.273
" of fore leg	.142
" " foot below	.032
" of hind leg	.165
" " foot below	.103

This species seems to be nearer to the *D. croconota* than to the *D prymnolopha.* Unfortunately I can find no skeleton or skull pertaining to the type, so that I can not describe their characters. It is much larger than the former species, exceeding it by more than six inches. Its uniform coloration is also entirely peculiar in the genus, for the hairs are not annulated. The feet are relatively much shorter than in the *D. croconota;* for according to Waterhouse, with a total length of 17 in. 9 lines, the feet of the latter measure (minus the nails) 3 in. 5 lines which is identical with the length of the foot in *D. aurea*, with a total of twenty-four inches. The head is the *D. croconota* measures 3 in. 11 lines. The relationships of the *D. rarea* appear to be with the *D. azaræ.*

38. Hydrochœrus capybara Erxl.

Four skeletons, one with a skin and a separate skull, all from Sao Joao.

39. Cavia aperea Erxl.

Four skins, three with skeletons, from Sao Joao.

LEPORIDÆ.

40. Lepus brasiliensis Linn.

Two skins with skeletons; three skins with skulls; six separate skins, and four separate skulls; all from Chapada.

CARNIVORA.

CANIDÆ.

41. Canis cancrivorus Desmarest.

Three skins with skeletons; one skeleton without skin, and one skin without skeleton, all from Chapada.

42. CANIS VETULUS Lund.

One skin with skeleton, and one separate skull, from Chapada.

43. CANIS ENTRERIANUS, Burmeister, Reise durch die La Plata Staten 1865, II, p. 400.

Two skins with skeletons, and one skin with skull, all from Sao Joao, Rio Grande do Sul.

I am not as certain of the identification of this species as I would wish, and find it easier to determine what it is not than what it is. It differs from the preceding two species as follows:

C. cancrivorus; Mandibular angle robust, truncate; posttympanic process adherent to bulla; larger; sectorial teeth relatively larger.

C. vetulus; mandibular angle slender, acute; posttympanic process adherant to bulla; smaller; sectorial teeth relatively small.

C. entrerianus; mandibular angle slender; acute; posttympanic process well posterior to bulla, but connected at base; larger; sectorial teeth relatively large.

This supposed *C entrerianus* agrees closely in general characters with the *C. griseus*, Gray, described by Burmeister [1] excepting in the superior size. It agrees in dimensions with the *C. azarae Cuv.* but differs from both that species and the *C magellanicus* Gray, in the possession of but one inferior premolar tooth with posterior cutting lobe instead of two. It also differs from both these species, and agrees with the *C. griseus* in the wide separation of the premaxillary and frontal bones. The general color is reddish, the hair on the anterior regions above, yellow near the tips, and brown at the tips, the brown becoming blackish on the posterior regions and the tail. Limbs light clean rufous; soles reddish brown. Belly and neck white, a gray band crossing just in front of the breast. Chin black except at tip, which is white. Upper surface of ears (which are large) bright rufous. The animal is at least as large as the red fox.

The coloration differs from that of *C. griseus* only in not showing the two white spots on the throat as described by Burmeister.

MUSTELIDÆ.

44. GALICTIS VITTATA Schreb.

Three skins with skeletons from Sao Joao.

[1] Erlaüterungen zur Naturgeschichte Brasiliens, 1856, p. 48.

45. GALERA BARBARA Linn.

Five skins with skeletons from Chapada.

46. LUTRA PLATENSIS Burmeister.

A skin and skeleton from Sao Joao; do. from Chapada; do without locality.

A comparison of the skulls of this species with two of *Lutra canadensis* in my collection, and three in that of the Academy of Natural Sciences, show the following differences. The palate is not so much produced posterior to the molar teeth: the superior tubercular molar has smaller anteroposterior diameters, especially at the interior extremity; and there is no preglenoid crest. The length of the skull is 103 mm., and the total length of the same individual is 1200 mm.

PROCYONIDÆ.

47. PROCYON CANCRIVORUS Cuvier.

Black-footed variety, Sclater, Proceedings Zool. Soc., London, 1875, p. 421.

One skin with skeleton of a male, and a separate skull; both from Sao Joao.

The skin is that of an adult male in excellent condition. The hair is dense and woolly on the body, but is very sparse on the anterosuperior faces of the feet. The tail is fusiform and bushy. The fundamental color is brownish-yellow above, but the hairs on the middle region of the back have long black extremities. The color below is light brownish yellow. The feet are all black up to the midde of the tibia and forearm. The tail is black, crossed by five annuli of yellowish brown.

For comparison with the skulls of this species I have eight of the *P. lotor* and two of the *P. hernandezii*. Of the former, one is from New York, and one from Pennsylvania; of the latter, one is from S. W. New Mexico, and one from Western Oregon. The characters of the *P. cancrivorus* are easily observable; while those of the two other species are also visible. I compare them in the following table:

I. Canines less compressed; metaconid of P. m. I. often present.

Postdental part of palate wider than long; malar bone weak; front narrow, width equal diameter of orbit; each nasal bone obliquely truncated; larger.

P. cancrivorus.

Postdental part of palate as wide as long ; malar bone very robust ; front wide, flat, exceeding diameter of orbit ; each nasal bone truncate with produced outer angle. *P. hernandezii.*

Postdental part of palate longer than wide ; malar bone robust ; front narrow, convex, width equal that of orbit; each nasal bone deeply emarginate distally.......*P. lotor.*

II. Canines much compressed ; metaconid of P. m. I. always wanting.

Muzzle shorter ; palate angularly elevated posteriorly ; last inferior molar wider, heel median ; larger...*P. nasicus.*

Muzzle longer ; palate nearly flat posteriorly ; last inferior molar narrower, the heel internal ; smaller.......*P. nasua.*

In the two specimens of *Procyon cancrivorus* before me the metaconid of the p. m. I. is well developed. In the *P. lotor* it is distinct in four out of eight skulls, and is represented by a mere trace in the other four. In a single *P. hernandezii* a trace only is visible. The form of the free extremity of the nasal bone is not constant in these species, and that of the last inferior molar will bear further examination.

The question is raised by Dr. P. L. Sclater, as above cited, as to whether the southern black-footed raccoon is specifically identical or distinct from the rufous-footed form from Surinam and Central America. In the lack of specimens of the latter region I cannot give a definite answer to this question.

In the skull of the *P. hemandezii*, above described, the *processus pyramidalis* of the palate has on its external face, a deep groove, bordered above and below by an alate crest, which are wanting in the *P. lotor*. The malar bone is also produced downwards at its inferior border next the maxillary, and the postorbital processes of the frontal and malar bones are both more distinct than in the *P. lotor*. Whether these are individual characters or not I cannot now determine.

48. Procyon nasua Linn. *Nasua rufa* Desm. Allen.
Three skins, with skeletons, all from Sao Joao.

49. Procyon rufus Desmarest.
Twenty skins, three with skeletons, and one with a skull ; seventeen separate skulls and eleven skeletons, all from Chapada.

The skins of the Coatis from the two localities, differ constantly

and essentially, so that there appears to me to be two species, or, perhaps, subspecies. The most important difference is in the shape of the naked part of the nose. In the *P. nasua* from Sao Joao, in each of the three specimens, this region is not longer than wide above, and is wider than deep below, being separated by a broad band of hair from the lip border. In the *P. rufus* this region is constantly at least twice as long as wide above, and much deeper than wide below, with an angular outline which approaches near to the lip border. In the *P. nasua*, the white on the upper lips is wide and conspicuous, and the cheeks and top of head are of a light gray or pale brown. The top of the nose is light except at the end, and the median head stripe when present is of a darker color than the top of the head. In the *P. rufus* the white line on the upper lip is very narrow or wanting, and the head is generally blackish gray, the color of the vertex continued on the middle line to the black of the top of the nose. In the *P. nasua* the general color is light brown or gray; below light yellowish brown. Less than half the leg is black. In the *P. rufus* the back is dark rufous, the hairs generally shortly, sometimes deeply, black tipped: belly and throat bright rufus, except the white chin. More than half the legs black.

The colors of these specimens are as constant as the different character of the naked nasal surfaces, and the resulting appearance is that of two species. The specimens of the *P. nasua* appear larger and more robust than those of the *P. rufus*. I cannot detect any difference in the skulls and teeth; there being no osseous character corresponding to the different proportions of the external nasal organs in the two species.

I find the characters pointed out by J. A. Allen[1] to distinguish the two Brazilian species from the Mexican, to hold good.

CERCOLEPTIDAE

50. Cercoleptes caudivolvulus Pallas.
A skull from Chapada.

FELIDÆ.

51. Uncia onca Linn.
One skin with skeleton, and three skulls, from Chapada.

52. Uncia concolor Linn.
One skull from Chapada.

[1] Bulletin of the U. S. Geolog. Survey of the Terrs, 1879, vol. v, p. 161.

53. Felis pardalis Linn.

One skin from Chapada.

54. Felis geoffroyi D'Orbigny.

One skin with skeleton from Chapada, and a skin with skeleton from Sao Joao.

55. Felis jaguarondi Lacep.

One skin with skeleton from Chapada, and a skull from the same locality.

56. Felis braccata sp. nov.

Size of *F. jaguarondi*. Claws very small, white. Tail to end of vertebræ extending one inch beyond extended posterior limbs. Fur of irregular lengths, mingled everywhere with numerous long hairs. Color above brown, the hairs on the middle of the back, and on top of head and muzzle, with several black sections, which give a mixed black and brown hue to those regions. Upper portion of limbs of the same color, interrupted by black cross-bands, two on the fore leg and three on the hind, the former extending on the inner face as well. Distal half of all the legs black, without brown intermixture. Ears of moderate size with an apical angle a little less than right; the anterior half black, the posterior half gray. Inferior surface anteriorly furnished with long hairs of a buff color, which with short hairs of the same color near the anterior margin, show from above, giving a narrow brown border. Hair of the muzzle terminating in a straight transverse line which extends between the posterior parts of the nostrils. Lip whiskers long, buff with black bases. Some slender superciliary vibrissæ. A buff spot below each nostril, and a similar one above the anterior part of each eye. Cheeks yellowish brown, hairs black-varied.

Chin very pale buff. This color deepens posteriorly, soon passing into the yellowish brown of the lower surfaces. Numerous white hairs are scattered on the thorax and abdomen, and numerous deep brown spots form transverse series, which sometimes become bands, mark the same regions. Three cross-rows of brown spots appear on the throat, the most anterior consisting of two small lateral, and a large median spot, crossing below the ears. The spots become more indistinct on the sides, and are wanting on the inferior surface of the tail. The latter is colored like the back above, and is black at the tip.

Measurements of the relaxed skin.

	M.
Length from end of muzzle to vent	.467
" of tail from vent to end of vertebræ	.230
" of ear above	.017
Width between bases of ears	.052
Length from anterior base of ear to end muzzle	.052
" of fore leg	.195
" of fourth anterior claw	.006
" of hind limb (approximate)	.195
" " " from vent	.220
" of second posterior claw	.005

This cat is evidently more nearly allied to the *F. jaguarondi* than to any other known species, and I need only point out the characters in which it appears to me to be distinct. The *F. jaguarondi* is evidently subject to considerable variation, but none of its forms approach sufficiently near to the *F. braccata* as to lead one to believe in the identity of the two. I have before me the skin of the *F. jaguarondi* above referred to from Chapada.

In what might be called structural differences I note the following. The feet of the *F. braccata* are smaller than those of the *F. jaguarondi*, and the toes are of more equal length. The claws are very much smaller. Both the internal and external toes are relatively considerably shorter on both limbs in the *F. jaguarondi* than in *F. braccata*. The fourth anterior and second posterior claws of the former species measure 6 and 5 *mm.* respectively; in the latter they measure 11 and 13 *mm.* respectively. The tail is rather shorter in the *F. braccata*, being less than the length of the body from the axilla to the vent, and only an inch in excess of the posterior legs extended posteriorly. The tail in the *F. jaguarondi* equals the body, and extends two inches beyond the limbs. This character may prove to be unimportant. Finally the ears in *F. jaguarondi* are broadly rounded; in *F. braccata* they are so prominently angular, as to present an apex rather less than a right angle. The fur of the muzzle has a truncate border, while in the *F. jaguarondi* the border presents an acute angle forwards, as it follows the superior outline of the nares above.

The differences in color are as follows:

The upper surfaces of the ears are like the top of the head in *F. jaguarondi;* in *F. braccata* they are of two colors in strong contrast, and both different from that of the head. In *F. jaguarondi* the in-

ferior surfaces are like the superior ; in *F. braccata* they are totally different, resembling various spotted cats. The legs are colored on the upper surface like the back in *F. jaguarondi*, and are black below; in *F. braccata* they are cross banded proximately, and the distal halves are totally black.

The aggregate of characters indicates the specific difference of the *F. braccata* from the *F. jaguarondi.* The only approach to any of the peculiar characters of the *F. braccata* in descriptions of the *F. jaguarondi*, which I can find, is in that by Mr. Alston in the Fauna Centrali-Americana, who states that there are transverse bars on the *inside* of the legs.

It is to be much regretted that the label belonging to this specimen has been lost. I do not know therefore whether it was obtained in the province of Rio Grande do Sul, or in Matto Grosso.

DIPLARTHRA.

TAPIRIDÆ.

57. TAPIRUS AMERICANUS Briss.

One skin with skeleton from Chapada.

HIPPOPOTAMIDÆ.

58. DICOTYLES LABIATUS Cuv.

One skin with skeleton from Chapada; six skins from Chapada; one skin from Sao Joao; two skulls from Chapada.

One of the skins from Chapada presents certain peculiarities. It is not larger than the *D. tajassu*, and the bristles are longer and denser along the back, and especially on the rump, than in the other skins. The dirty white or yellowish part of the hairs is replaced by red-orange, giving the animal a fiery tint when the bristles are erected. It was labelled "red-pig" by Mr. Smith. Unfortunately its skull was not preserved. It does not appear to me to represent anything but a slight variety; perhaps it is a young male. In all the characters of the feet, muzzle, etc., it agrees with the *D. labiatus*.

59. DICOTYLES TAJASSU Linn.

Two skins with skulls from Chapada ; two separate skins from do.; three skeletons from do.; thirteen skulls, do.; one skull from Sao Joao.

On comparing the sixteen skulls from Southern Brazil with five skulls in my collection, and one in the Museum of Princeton College, from Texas, I find such constant and important difference as to

satisfy me that the two forms cannot be regarded as specifically identical. Their differences may be compared as follows:

D. tajassu. Malar crest terminating above infraorbital foramen; nasal bones rounded in cross-section; first superior premolar (fourth of old works) tritubercular or rounded in outline, premolariform; molars not wrinkled.

D. angulatus sp. nov. Malar crest continued forwards to base of canine alveolus; nasal bones pinched or angulate on the middle line; first superior premolar quadritubercular, with intermediate tubercles, and quadrate in outline, molariform; molars wrinkled.

The characters cited are constant, although the amount of angulation of the nasal bones in the *D. angulatus* is subject to some variation. Another character, generally constant, is the form of the fossa above the diastema. In *D. tajassu* it is a narrow groove; in *D. angulatus* it is a wide fossa. On comparing two Texan skins with five from Brazil, I notice but one distinctive character. The naked spot on the rump is very much larger on the former, and it is followed by a large patch of brown hairs, forming a distinct spot. In the *D. tajassu* the brown hairs exist, but in smaller numbers, and they are completely covered by the black hairs which are mixed with them. The feet have been cut off from my Texan skins, and those of other specimens are in skeleton, so that I cannot compare the hoofs. The Texan skulls average larger in dimensions than those from Southern Brazil.

The characters of the first premolar, and of the dentition generally, are well represented by Professor Baird, but the prolongation of the malar angle and the roof-shaped nasal bones are not very clearly expressed in the outline figures he has given.[1] His specimens came from the Rio Grande. Mine are, one from the Guadalupe R., two from the Llano R., and two from a tributary of the Red River.

The character of the first premolar in the *D. angulatus* approximates it to the *D. nasutus* Leidy.

CERVIDÆ.

60. CARIACUS CAMPESTRIS F. Cuv.

One skin with skeleton; three skins, and three skulls; all from Chapada.

[1] U. S. Mexican Boundary Survey, Pl. xxvii.

61. COASSUS RUFUS F. Cuv.

One skin with skeleton: one skin with skull; two skulls with skin of head, and six separate skulls, all from Chapada.

62. COASSUS SIMPLICICORNIS Illiger.

One skin with skeleton; one skin with skull; three skins and three skulls, all from Chapada.

QUADRUMANA.

CEBIDAE.

63. MYCETES SENICULUS Linn.

Very abundant at Sao Joao do Monte Negro. Varying in color from bright rusty red, to brownish black with dark rusty crown. No specimens from Chapada.

64. MYCETES BELZEBUL Linn.

Three specimens from Chapada Matto Grosso. The skull of this species does not differ from that of the last. The hair differs, especially on the head. It is procumbent and radiates in all directions from a point on the middle line posterior to the ears. It points directly forwards on the crown and front to the base of the nose, and anterior eyebrows, when it is met by hair directed upwards and backwards, forming a low tranverse elevation bordering the front, much as described by Slack in the *M. niger*. In the *M. seniculus*, the hair of the crown is erect and woolly from front to rear.

65. CEBUS CIRRHIFER. G. St. Hilaire.

One adult (female) from Sao Joao.

66. CEBUS ELEGANS G. St. Hilaire.

Abundant at Chapada. In the males there is generally a low sagittal crest, the glabella is swollen, and the frontal profile is convex. In the females there is no sagittal crest, the glabella is less swollen and the front is less convex. In the specimen above referred to, the *C. cirrhifer*, the characters of the skull are like those of the female *C. elegans*, but the front is flatter in profile.

SYNOPSIS.

The species obtained by the Naturalist expedition are distributed as follows, as to numbers and localities:

	Total.	Sao Joao.	Chapada.
Marsupialia....................	4	1	4
Chiroptera......	9	3	6

Rodentia.....	17	9	10
Edentata....	9	3	9
Carnivora....................	16	6	12
Diplarthra....................	6	2	6
Quadrumana..................	4	2	2
	65	26	49

In the following lists the species of Sao Joao and Chapada are compared :

SAO JOAO.	CHAPADA.
MARSUPIALIA.	
Didelphys marsupialis azaræ.	*Didelphys marsupialis azaræ.*
" " *auritus*	
	Philander pusillus.
	Chironectes memina.
EDENTATA.	
	Myrmecophaga jubata.
Myrmecophaga bivittata.	" *bivittata.*
	" *? sellata.*
Xenurus gymnurus.	*Xenurus gymnurus.*
	" *hispidus.*
	Dasypus sexcinctus.
	Priodontes maximus.
Tatusia peba.	*Tatusia peba.*
	" *megalolepis.*
RODENTIA.	
Sciurus æstuans.	*Sciurus variabilis.*
Cricetus sp.	*Cricetus* sp.
	Cricetus sp.
	Cricetus sp.
Dactylomys amblyonyx.	
Sphingurus sericeus.	*Sphingurus prehensilis.*
Cœlogenys paca.	*Cœlogenys paca.*
Dasyprocta azaræ.	*Dasyprocta azaræ.*
	" *aurea.*
Hydrochærus capybara.	
Cavia aperea.	
	Lepus brasiliensis.
CHIROPTERA.	
	Phyllostoma hastatum.
	Carollia brevicauda.
	Artibeus planirostris.
	" *bilobatus.*
	Wampyrops lineatus.
	Sturnira lilium.

Desmodus rufus.	
Nyctinomus brasiliensis.	
Vesperus arge.	
CARNIVORA.	
Canis entrerianus.	*Canis cancrivorus.*
	" *vetu us.*
Galictis vittata.	*Galera barbara.*
Lutra platensis.	*Lutra platensis.*
Procyon cancrivorus.	
" *nasua.*	*Procyon rufus.*
	Cercoleptes caudivolvulus.
	Uncia onca.
	" *concolor.*
	Felis pardalis.
Felis geoffroyi.	" *geoffroyi.*
	" *jaguarondi.*
	" *braccata.*
DIPLARTHRA.	
	Tapirus americanus.
Dicotyles labiatus.	*Dicotyles labiatus.*
" *tajassu.*	" *tajassu.*
	Cariacus campestris.
	Coassus rufus.
	" *simplicicornis.*
QUADRUMANA.	
Cebus cirrhifer.	*Cebus elegans.*
Mycetes seniculus.	*Mycetes belzebul.*

From the preceding lists, it appears that but ten species were procured at both localities. Of the thirty-one genera obtained at Chapada sixteen were found at Sao Joao. Of the twenty-three genera found at Sao Joao, sixteen were obtained at Chapada. Of especial peculiarity of the Sao Joao collection may be mentioned the absence of the water opposum, the tayra, the six banded and giant armadillos, and of all the leaf-nosed bats. Also the absence of most of the cats, including the jaguar; also the absence of the deer. The Chapada collection lacks the crab-eating raccoon, and the gray coati; the capybara and the wild guinea-pig; and the bats of the families Emballonuridæ and Vespertilionidæ.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

At the last meeting of the Society of Charities and Corrections the Rev. Oscar C. McCulloch, of Indianapolis, read a paper on the Tribe of Ishmael, in which he detailed the result of his studies on the pauper families of Indianapolis. The story he tells is a sad one. It is the history of generation after generation of paupers and criminals, of people sunk so low as not to have the slightest aspiration for a better life, who obey Scriptural injunctions only in that they are fruitful and multiply their vicious kind. Five generations of thirty families are traced, and of all the individuals whose records are worked out, but one ever emerged into a respectable life. This Tribe of Ishmael is but a repetition of the Jukes family, but it brings again to prominence a problem with which society has to deal. What shall be done to check the growth of these and similar parasites? They are sunk to a depth where no church can reach them; the so-called charity which gives to beggars and which patronizes the halt and maimed but encourages them in their present life; our present laws having no terrors for them, for imprisonment means but a winter of warmth, comfort and idleness. Were pauperism and beggary the only sins of these people then existence might be endured, but in the case of both the Jukes family and this tribe of Ishmael—and the same is true of all other similar families—every species of crime from murder down has been perpetrated by its members.

What can society do to protect itself against these pests? is a question which must be answered. Growth of cities means a disproportionate increase of this undesirable class. An answer seems difficult; in fact, we can only see one direction from which relief can come. The teaching of evolution must be recognized and incorporated in our laws. Evolution teaches that variation, the influence of environment, and adaptability to changed conditions are important factors in organic life, but it also teaches that these are fixed and perpetuated by heredity. It is this aspect of evolution that seems to point to the answer. The children of these people inherit scarcely a good trait, but are heirs to all that is vicious and criminal in their parents. They are begotten in criminality, nur-

tured in vice, and their maturity is crime. Our good people should refrain from indiscriminate alms giving, for this is offering a premium for a continuance of present conditions, and our laws should recognize the existence of heredity and make provision whereby the reproduction of this inherited vice could be checked. Such laws may seem harsh, but consider for a moment the saving to the country had the notorious Margaret, the mother of the Jukes family, been imprisoned so that none of her illegitimate children could have come into the world. Such a step would have been deemed cruel, but in the light of what we now know of the criminality of her descendants, society would have been justified in such extreme measures. The record of her children is but a continuous account of murder, highway robbery, burglary and prostitution, while the cost of prosecuting these criminals mounts up into the hundreds of thousands of dollars.

RECENT LITERATURE.

THOMAS' CATALOGUE OF MARSUPIALIA AND MONOTREMATA.[1]—This publication is very timely, as it places in the hands of students the means of becoming acquainted with the characters of the species of the important orders named, at a time when it is important that they should have the knowledge. The Marsupialia are arranged in six families, of which three are referred to the Diprotodontia, and three to the Polyprotodontia. The species number as follows :

Diprotodontia.		*Polyprotodontia.*	
Macropodidæ,	56	Peramelidæ,	14
Phalangeridæ,	34	Dasyuridæ,	26
Phascolomyidæ,	3	Didelphidæ,	24
Totals.	93	Totals.	64=157

The systematic treatment is conservative, and in the main satisfactory. Tarsipes seems, however, to deserve family recognition. In the matter of species the novel proposition is maintained that the larger South American opossums are only variations of the species with which we are familiar in this country. *Didelphys cancrivora*, *aurita*, *azaræ*, and *albiventris* become synonymous of *D. marsupialis* L. (=*D. virginiana* Kerr).

[1] Catalogue of the Marsupialia and Monotremata in the Collection of the British Museum. By Oldfield Thomas, 1888, pp. 401 ; xxviii plates.

We have fault to find with the lettering and other signs affixed to the paragraphs of the analytical keys of the various divisions. Were it not for the indenting and correct ranging of these paragraphs, their relations to each other could be only discovered by a considerable study of the signs affixed, and then many students, we suspect, would be hopelessly confused. The same system or *unsystem* has been adopted by Mr. Dobson in his catalogue of Chiroptera. It is to be sincerely hoped that in future the taxonomic keys may be arranged on the usual plan, such as for instance is employed by Mr. Boulenger in his catalogues of the Batrachia and Reptilia.

The twenty-eight plates are a welcome aid to the study, but the dental cusps are often poorly represented.

THE CLASSIFICATION OF THE CRINOIDEA appears now to have reached sound and rational basis as is clearly set forth in a recent important contribution[1] to Crinoid morphology by Messrs. Charles Wachmuth and Frank Springer. Although the subject is approached chiefly from a palæontological standpoint, morphological deductions derived from the latest researches among living crinoids have been duly considered. The systematic arrangement of the Crinoidea as indicated is of not less supreme interest to the palæontologist than to the biologist; and the classification as now proposed appears to be practically in agreement with the views of Dr. P. Herbert Carpenter, the distinguished English authority on recent crinoids. The necessity of a radical change in the existing classification centers around the discovery of the ventral structure in *Taxocrinus*. It is now clearly demonstrated that in this genus, and doubtless in the Ichthyocrinidæ generally, the mouth is open, and surrounded by five conspicuous oral plates, as in the recent genera *Rhizocrinus*, *Bathycrinus*, *Hyocrinus* and *Holopus*; thus differing in structure very materially from other palæozoic crinoids, which have the mouth closed. In the latter group, as is now conclusively shown, the orals are the hitherto denominated "central" and four "proximate" plates. The plan upon which modern crinoids are constructed is therefore one of high antiquity, dating back geologically to the Lower Silurian.

The Crinoidea are thus divisible into

1. Camarata.
2. Inadunata, comprising the branches Larviformia and Fistulata.
3. Articulata, including Ichthyocrinidæ and possibly *Uintacrinus* and *Thaumatocrinus*.
4. Canaliculata, including most of the mesozoic and recent crinoids.—*C. R. K.*

[1] Discovery of the ventral structure of *Taxocrinus* and *Haplocrinus*, and consequent modifications in the classification of the Crinoidea.—By Charles Wachsmuth and Frank Springer. Proceedings of the Academy Natural Sciences. Philadelphia, Nov. 27, 1888.

FRITSCH AND KAFKA'S CRUSTACEA OF THE BOHEMIAN CRETACEOUS.*—This elaborate folio memoir of 54 pages is richly illustrated by ten plates printed in colors and 72 woodcuts, giving both views of the actual specimens and what appear to be excellent restorations of some of the more interesting forms.

Beginning with the cirripedia of the Bohemian chalk, remarks are made on the species, most of which have been previously described by the authors, but the new details and excellent figures add much to our previous knowledge. The same may be said of the Ostracoda which are illustrated by 20 figures in the text. The richest material consisted of the remains of Decapoda, especially the Macrura, and this is the most valuable and interesting portion of the work. Some of the new material in this order belongs to the Palinuridæ. Our knowledge of the extinct Mesosoic family Glyphæidæ, so well developed in Belgium by Winckler, is farther extended by the full accounts of the remains of *Glyphaea bohemica* Fr., the figures including a restoration. Of the family, Astacomorpha *Enoploclytia leachii* Mantell is fully restored, with dorsal and side views, and the text contains a very detailed description. The same may be said of *Schlüteria tetracheles* Fr., and of the species of Hoploparia, Paraclatia, and Stenocheles. Further information of the Cretaceous specimens of Callianassa is given with a restoration, while new facts and figures concerning the Dromiacea, Oxystomata and other Brachyura complete the work, which as a whole is a most valuable contribution to our knowledge of extinct Crustacea.—*P.*

RECENT BOOKS AND PAMPHLETS.

American Society of Naturalists. Vol. I. Part Fifth.

Boettger, Oscar.—Aufzahlung einger neu erworbener Reptilien und Batrachier aus Ost-Asien. Beitrag zur Reptilfauna des obern Beni in Bolivia. Bericht Senckenberg Naturforsch. Gess. Frankfurt, 1887-'88. Both from the author.

Brinton, D. G.—Obituary notice of Philip H. Law, Esq. Read before the American Philolosophical Society, Oct. 19, 1888. From the author.

Goode, G. Brown.—The Beginning of American Science in the Third Century. From the author.

Buller, Walter L.—Catalogue of the Collection of New Zealand Birds in the Manor House. Letcombe Regis, Wantage. Petherick and Company, London.

*Die Crustaceen der Böhmischen Kreide formation. Von Dr. Ant. Fritsch und Jos. Kafka. Prag., 1887.

Clark, Wm. B.—Discovery of Fossil-bearing Cretaceous Strata in Anne Arundel and Prince George Counties, Maryland. Reprint from Johns Hopkins University Circulars. No. 69. From the author.

Cooke, W. W.—Report of Bird Migration in the Mississippi Valley in the years 1884 and 1885. Edited and revised by Dr. C. Hart Merriam. From U. S. Agricultural Dept.

Dawson, George M.—Glaciation of British Columbia. Extract from Geological Magazine, Aug. 1888. From the author.

Dawson, William J.—Specimens of *Eozoon canadense* and their Geological and other Relations. From the author.

Dollo, L.—*Achenosaurus multidens.* Extrait du Bulletin de la Société Belge de Géologie, Tome II., 1888. From the author.

Dollo, Louis.—Sur la Signification du "Trochanter Pendant" des Dinosauriens. Extrait du Bulletin Scientifique de la France et de la Belgique.

Doua, G.—Note Erpetologiche. From the author.

Dugés A.—Description of *Storeria dekayi, var anomala.* Extract from Proceedings of U.S. Nat. Museum, 1888. From the author.

Ganong, W. F.—The Echinodermata of New Brunswick. Extract from Bulletin of New Brunswick Natural History Society. From the author.

Gilbert, G. K.—Changes of Level of the Great Lakes. Reprint from the Forum. Vol. V., 1888. From the author.

Gould, George M.—Is the Electric Light Injurious to the Eyes. Reprint from the Medical News, Dec., 1888.

The Psychological Influence of Errors of Refraction and of their Correction. Reprint from the Medical and Surgical Reporter, Sept., 1888. From the author.

The Homing Instinct. Reprint from Progress, Oct., 1888. From the author.

Henshall, James A.—Contributions to the Ichthyology of Ohio. —Some Peculiarities of the Ova of Fishes. Reprints from the Journal Cin. Society Natural History, 1888. Both from the author.

Hicks, Lewis E.—Irrigation in Nebraska. Extract from Bulletin of Nebraska Agricultural Station. Vol. I. From the author.

James, Joseph F.—The Ivorydale Well in Mill Creek Valley. An Ancient Channel of the Ohio River at Cincinnati. Reprints from the Journal of the Cin. Society Natural History, 1888.

Jordan, David Starr.—Manual of the Vertebrates. Revised and enlarged. From the publisher.

Keyes, Charles R.—On the Forms of the Lower Coal-Measures of Central Iowa.—Descriptions of Two New Fossils from the Devonian of Iowa. Reprint from the Proceedings of the Phila. Academy of Natural Sciences. From the author.

Lord, William R.—Homing of Dogs. From the author,

Langley, S. P.—Energy and Vision. Reprint from American Journal of Science. Vol. XXXVI., Nov., 1888. From the author.

Lydekker, R.—Catalogue of Fossil Reptilia, &c. Extract from the Geological Magazine, Oct., 1888. From the author.

Macoun, John.—Catalogue of Canadian Plants, Part IV.—Endogens. From the Geol. and Nat. Hist. Survey of Canada.

Le Marquis de Saporta.—Origine Paléontologogique des Arbres cultivées ou utilisés par l'homme. From the author.

Mitchell, Henry.—On the Circulation of the Sea through the New York Harbor. From U. S. Coast and Geodetic Survey.

Müller, Max F.—Science of Thought. From the publishers.

Newberry J. S.—The Coals of Colorado. Ext. from the School of Mines Quarterly, Vol. IX, No. 4, July, 1888. From the author.

Orr, Henry.—A Contribution to the Embryology of the Lizard. Reprint from the Journal of Morphology, Vol. I., No. 2, Dec., 1887. From the author.

Bulletin No. 2, *Bulletin No.* 3.—Ohio Agricultural Experiment Station.

Osborn, Henry Fairfield.—Additional Observations upon the Structure and Classification of Mammalia. Ext. from Proceedings of Phila. Academy Nat. Science, Oct., 1888. From the author.

Packard, A. S.—Aspects of the Body in Vertebrates and Arthropods. Reprint from Am. Nat., Sept., 1884. From the author.

Penna. State College Agricultural Station, Bulletin No. 3, Bulletin No. 4.

Pennsylvania Geological Survey, Atlas Bucks and Montgomery Counties.—Atlas Eastern Middle Anthracite Field, Part II.—Atlas Western Middle Anthracite Field, Part II.—Atlas Northern Anthracite Field, Part II.—Atlas Annual Report, 1886, Part III.—Annual Report, 1886, Part IV. and Atlas. From the Survey.

Pennsylvania State College Agricultural Station. Bulletin No. 5, October, 1888.

Report of the Pennsylvania State College for the year, 1887. Part II.

Report of Trustees of Peabody Museum of Am. Archæology and Ethnology, V. IV, No. 1.

Poulton, Edward B.—The True Teeth and the Horny Plates of Ornithorhyncus. Reprint from the Quarterly Journal of Microscopical Science. From the author.

Preliminary List of the Lower Crustacea of Staten Island. From the Proceedings of the Natural Science Association of Staten Island.

Read, M. C.—Archæology of Ohio. From the author.

Renard, A.—Recherches sur la Composition et la Structure des Phyllades Ardennais. Extrait du Bulletin du Musée Royal d'Histoire Naturelle de Belgique. Tome III. From the author.

Riley, Charles V.—Report of the Entomologist for the year 1887. (with illustrations). From the author.

Seeley, H. G.—On the Dinosaurs of the Maastricht Beds.—On a Sacrum of a Bird from the Wealden of Brook. Reprints from the Quarterly Journal of the Geological Society, May, 1887. On the Nature and Limits of Reptilian Characters in Mammalican Teeth—Researches on the Structure, Organization, and Classification of the Fossil Reptilia—On the Classification of Fossil Animals commonly named Dinosauria—On the bone in Crocodilia which is commonly regarded as the Os Pubis, and its representative among the Extinct Reptilia—On Parieasaurus bombidens (Owen), and the significance of its affinities to Amphibians, Reptiles, and Mammals. Reprint from Proceedings of the Royal Society. Vol. 42, 43, 44. From the author.

Chapman, Henry C.—Observations on the Female Generative Apparatus of *Hyæna crocuta*. Ext. Proceedings, Phila. Academy of Natural Science. June, 1888. From the author.

Slade, D. D.—On certain Vacuities or deficiencies in the Crania of Mammals. Bulletin of Harvard Museum of Comparative Zoology, Vol XIII., No. 8. From the author.

Smiley, Charles W.—Altruism Considered Economically. From the author.

Smock, John C.—Building Stone in the State of New York. Bulletin of the New York State Museum of Natural History. No. 3. March, 1888. From the author.

Taylor, Edgar W.—Geology in our Preparatory Schools. Reprint from the American Geologist, May, 1888. From the author.

Tyndall, John—Diamagnetism and Magneto-crystallic Action. Appleton and Company, New York.

Tyrrell, J. B.—Report on Portions of Northern Alberta, Assiniboia and Saskatchewan. Part E., Annual Report 1886, Canadian Geol. Survey.

Tuckerman, Frederick—Supplimentary Note on *Tænia saginata.* From the author.

Vaillant, Léon M.—Note Complementaire sur l'antomie de *l'Anai des lugubris* Hallowell.—Remarques sur le genre Ripistes de-Dujardin. Extraits du Bulletin de la Société Philomatique de Paris, 1885—1886.

Vanfleet, W.—Some Native Birds for Little Folks. From the publishers.

Von Klein, Carl H.—Address on Rhinology. Reprint from the Journal of the American Medical Association. From the author

Ward, Lester F.—Our Better Halves. Reprint from The Forum, Vol. VI. From the author.

Civil Service Reform. Reprint from The Historical American, July, 1888, Vol. I. No. I.—What Shall the Public Schools Teach? Reprint from The Forum. Both from the author.

Weithofer K. Ant.—Einige Bemerkungen über Carpus der Proboscidier. From the author.

Woodward, A. Smith.—A Comparison of the Cretaceous Fish-fauna of Mount Lebanon with that of the English Chalk. Ext. from the Annals and Magazine of Natural History. On the Genus Synechodus.—Note on the Occurrence of a Species of Onychodus in the Lower Old Red Sandstone Passage Beds of Sudbury, Herefordshire. Extracts from the Geological Magazine. From the author.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL[1]

Africa, The Western Sahara.—As Spain has recently annexed the African coast between Morocco and Cape Blanco, with an indefinite extension inland, the geography and ethnography of these regions is naturally prominent in Spanish geographical papers. Sres. Coello, Cervera, Quiroga, and Costa have recently explored this region, especially that part known as the Adrar Temar which is a raised oasis or meseta containing an area equal to a sixth of that of Spain. The mesa terminates in a point towards the south and is crossed here and there by ranges of hills, which have a slighter slope in its

[1] Edited by W. N. Lockington, Philadelphia, Pa.

eastern than in its western portion. In the centre opens the principal valley, that of Atar, which runs from north-west to south-east, and is the most thickly-populated part of the oasis. The greatest height of these hills is not more than 125 metres and most are much lower. The shifting sand-dunes which surround the whole of the oasis have penetrated between the two principal ranges of hills until they reach the walls of the towns of Uadan and Xingueti. The hills of Adar contain pines (*P. maritimus*) and several other kinds of trees, with spiny shrubs and herbage which grows even among the sand. Gazelles and other antelopes, foxes, hares, porcupines, etc., are among the wild animals. The natives have herds of oxen and buffaloes and flocks of sheep and goats; they cultivate wheat, barley, millet, sorgum, maize, cucumbers, etc., and tobacco; but have no olives, figs, or oranges. Their principal article of food is the date. Everywhere in the Sahara there is water beneath the surface, often at a slight depth. The oasis is salubrious; and the temperature varies from 4 to 40 degrees, centigrade. The inhabitants of Adrar are Berbers, and some preserve the type tolerably pure, though as a whole they are mixed with Arab and Negro. They are divided into four castes, sacerdotal, warrior, plebeian, and slaves; the noble or warrior class being the owners of the soil. The civil and religious head of this people is a hereditary sovereign, but the real power in each tribe is in the hands of an assembly of notables. A hundred slaves form the bodyguard of the king, who resides in Atar. Most of the natives belong to the mussulman sect of the Dyilani, whose religious head or Great Makkaddem resides at Uadan.

Xingueti, the most populous town of the oasis, contains from 3 to 4,000 souls; Atar 2,000 to 2,500; Uyeft about 1,500, while Uadan, which in the XVI. century was the capital, has greatly decayed. There is another Adrar, the Adrar Sutuf, about which less is known. The district next the coast and between the two Adrars is known as Tiris, and its inhabitants are shepherds and guides of caravans. In this country there are some curious rocks that are wider at the top than at the bottom, looking like basaltic monuments. At some points the basalt is formed into great arcades like those of an aqueduct. The districts called Skarna and Semmur form the drainage area of the Seguia-el-Hamra, which may be called a river though it has no perennial flow. Yet the Seguia is never entirely dry and there must be springs at certain points; it has many affluents, and the whole basin is humid and very productive. The indolent inhabitants are more given to the chase than to cultivation.

The most powerful tribes are those of the Erguibat, who reside in the upper part of the river. This tribe sends caravans in all directions, some having as many as a thousand camels guarded by two to three hundred armed men. The small commercial town of Tenduf belongs to the tribes of the Tadyacant.

The Oasis of Figuig.—France has intended to annex the oasis of Figuig, which is situated near Algeria, south of the mountains of Maiz and Beni-Smir. This territory is in Morocco and pays a small tribute to the Sultan, but is practically independent. The people are freebooters and their excursions have given the French government the pretext for claiming damages against the Sultan of Morocco. The last governor of Figuig was a fanatic Musselman and stirred up against the infidel rulers of Algeria all the Arabs under his jurisdiction. Three employes of the Algerian government were taken prisoners, and the French, after occupying with their forces the railroad fom Saida to Ain Sefra, have procured the dismissal of the governor of Figuig.

Geographical News.—The Philippine Islands, although probably the most valuable of Spain's remaining possessions, and although their productions are exceedingly rich and varied, have not hitherto attracted emigrants from the mother country. It is now proposed to choose for colonization the Island of Paragua, not more than a thousandth part of which is at present occupied by settlers, the remainder being the exclusive property of the State. The forest riches of Paragua are immense, the species including some that are not known in the rest of the archipelago. Among these is *Fragosa peregrina*.

Without the province of Algeria or the protectorate of Tunis, the French "colonies" or possessions, scattered over the four quarters of the world, contain an area of more than two millions of square kilometres, and a population of rather more than twenty-two millions, without including that of the Congo and Gaboon territory. The colony of Senegal contains about 805,000 square kilometres and that north of the Congo at least 600,000.

GEOLOGY AND PALÆONTOLOGY.

The Vertebrate Fauna of the Equus Beds.—While the Equus Beds are found at various localities in North America, the greater number of characteristic species of Vertebrata have been obtained in three regions. First, the Oregon Desert; second the Country of the Nueces, S. W. Texas; third the Valley of Mexico. I give lists of the species found at these and their localities.

Recent species are indicated by a *

1. The species found in the Oregon Desert are the following:

MAMMALIA.

Holomeniscus vitakerianus Cope.
" *hesternus* Leidy.

Eschatius longirostris Cope.
" *conidens* Cope.
Equus major Dekay.
" *occidentalis* Leidy.
" *excelsus* Leidy.
Elephas primigenius Blum.
Canis latrans Say*.
Lutra ?piscinaria Leidy.
Castor fiber L.*
Arvicola sp.
*Thomomys talpoides** Licht.
" ? *clusius** Coues.
Mylodon sodalis Cope.

AVES.

Podiceps occidentalis Lawr.
" *californicus.**
*Podilymbus podiceps.**
Graculus macropus Cope.
Anser hypsibatus Cope.
" *canadensis* L. *
" *albifrons gambeli.**
" near *nigricans* Lawr.*
Cygnus paloregonus Cope.
*Fulica americana.**
And numerous other species.

PISCES.

Leucus altarcus. Cope.
Myloleucus gibbarcus Cope.
Cliola angustarca Cope.
Catostomus labiatus Ayres.*
" *batrachops* Cope.

II. From S. W. Texas we have the following species.[1]
Equus barcenæi Cope.
" *fraternus* Leidy.
" *excelsus* Leidy.
" *occidentalis* Leidy.
" *crenidens* Cope.
Elephas primigenius Blum.
Canis sp.
Glyptodon petaliferus Cope.
Cistudo marnochii Cope.

III. From the Valley of Mexico the following have been recorded.[2]

[1] See American Naturalist, 1885, p. 1208.
[2] Proceeds. Amer. Philos. Society, 1884, p. 1.

Bos latifrons Harl.
Eschatius conidens Cope.
Holomeniscus sp. minor.
" *hesternus* Leidy.
" sp ? *californicus* Leidy.
Platygonus ?compressus Lec.
Equus barcenaei Cope.
" *excelsus* Leidy.
" *tau* Owen.
" *crenidens* Cope.
Elephas primigenius Blum.
Dibelodon shepardi Leidy.
Canis sp.
Ursus sp.
Glyptodon ? petaliferus Cope.
Mylodon sp.

IV. The following species were derived from a locality in Whitman Co., Tacoma (or Washington).

Mylodon sp.
*Taxidea americana** (*T. sulcata* Cope.)
Equus sp.
Holomeniscus sp.
Holomeniscus sp.

ALCES BREVITRABALIS, sp. nov.

This deer is represented by the basal part of the antler of three large and one small specimens. They agree with those of the genus Alces in the absence of a brow-antler, and the flattening of the beam preparatory to a palmation. The palmate part of the horn is lost from all the specimens. It was probably not nearly so extensive as in *Alces machlis* since its base is not wider than that of the bezantler. The beam is short, and becomes rapidly much compressed in a plane transverse to the axis of the skull (judging by the obliquity of the base), which is also the plane in which the equally compressed bezantler is given off, in the external direction. The surface is not very rough, nor are the tubercles of which the burr consists, very large. A few nutritious grooves are well-marked. The external edge of the beam becomes truncated towards the base, and the section of the latter is a spherical triangle, transversely placed, with the external apex more or less obtuse.

Measurements of No. 1.

		M.
Diameters at base of beam	anteroposterior	.043
	transverse	.058
Length to base of bezantler		.100

No. 2.

Long diameter of bezantler at base	.045

In No. 2 a tuberosity on the external face of the beam a short distance above the base, represents the brow-antler.

As compared with the year-old moose of which a figure is given by Prof. Baird (Rept. U. S. Pacific R. R. Exped. IX, p. 632), these horns differ in the relatively shorter and more compressed beam, with the less expansion of the portion immediately distad to the bez-antler.

The specimens of this species are all from Whitman County, Tacoma (Washington), and were obtained by Dr. J. L. Wortman.

ALCES SEMIPALMATUS sp. nov.

This species of elk is known to me from a basal portion of a horn of a larger individual, and the corresponding part of a smaller one. The larger specimen is considerably smaller than the adult of the *A. brevitrabalis*, representing a species of about the size of the black-tailed deer (*C. macrotis*), while the latter is as large as the *Cervus canadensis*. It differs from the *A. brevitrabalis* in the relatively and absolutely longer beam, and the relatively greater expansion at the base of the bezantler. The general characters are otherwise much as in that species. The beam is compressed, with the external face truncate, and the bezantler directed outwards in the plane of the beam. The burr is very prominent, consisting of a rim of confluent tubercles. The beam is smooth on the sides, but has several tubercles on the external border. Unfortunately the beam is so split that its transverse diameter can be only surmised, from the curves of its surface.

Measurements.

		M.
Diameters at base of beam	anteroposterior	.015 to .020
	transverse	.030 to .035
Length of beam to base of bezantler		.120
Long diameter of bezantler at base		.035

Besides the greater length of the beam, its expansion near the base of the bezantler and away from it, is greater than in the larger species above described, and the concavity of the surface is wider.

From Whitman Co., Tacoma, Dr. G. M. Sternberg, U. S. A.

CARIACUS ENSIFER, sp. nov.

This deer is represented by the beams of the horns of two individuals of probably different ages. In one of them a considerable part of the beam is preserved, so that a good idea of its characters may be obtained. It differs from both of the other species described in the presence of a short brow-antler, which originates exactly at the base of the beam, and is directed horizontally. It is depressed and not very long, and is accompanied by a twin process at its base, with which it is united by a horizontal lamina or palmation. The beam is, like that of the species already described, compressed, with a flattening of one edge, that immediately above the brow-antler. A similar flattening characterizes the base of the external edge,

which is not wider than the internal base, the reverse of what is seen in the *Alces brevitrabalis*. The beam soon becomes compressed, especially on the antero-external edge (above the brow-antler), and in the specimen where it is best preserved, it is quite acute. In neither specimen is there any indication of a bezantler. The longer specimen may be possibly young, but its surface is strongly keeled and furrowed. The burr consists of acute edges connecting sharp points. The other specimen is smoother and rather more robust. It shows no indication of the expansion of the species referred to Alces, which it would do were it proportioned as in the *A. brevitrabalis*.

Measurements. No. 1.

		M.
Diameters at base of beam	anteroposterior	.022
	transverse	.035
Estimated length of brow-antler above		.040
Diameters beam .090 M. from burr	anteroposterior	.007
	transverse	.025

From Whitman Co., Tacoma, Mr. C. H. Sternberg.

This species is referred to Cariacus, although the position and direction of the brow-antler are different from those of any known species of the genera. I suppose it to be one of the Telemetarcapi solely from its resemblance to the Alces here described.

Several species have been found in localities not far removed from those mentioned, and in beds possibly of the same geological age. As it is not yet possible to determine with accuracy the ages of these fossils, I only refer to them. Such are an Aphelops from the valley of Toluca, Mexico; and *Mastodon americanus* and *M. serridens* from S. W. Texas.

The close parallelism between the faunæ at the three localities is seen in the probable and ascertained identity of several species in the lists of each. The following species have been found in the two regions most remote from each other, the valley of Mexico and the Oregon Desert.

Eschatius conidens Cope.
Holomeniscus hesternus Leidy.
Equus excelsus Leidy.
Elephas primigenius Blum.

Of these, the *Equus excelsus*, and *Elephas primigenius* have been found in S. W. Texas. These species, with the *Equus barcenæi*, *E. crenidens*, and probably the *Glyptodon petaliferus* are common to the last named locality and the valley of Mexico.

The horizon to which these beds should be referred was held by King to be the Upper Pliocene. I have coincided with this opinion on palæontologic grounds, since the fauna presents a much greater diversity from that now inhabiting North America than that of the Plistocene beds of Europe exhibit when compared with the existing

Vertebrata of that country and Asia. Four families have disappeared since that epoch, viz.: The Glyptodontidæ, Megatheriidæ, Elephantidæ and Eschatiidæ. The genus Holomeniscus has passed away. The disproportion of extinct forms increases as we go south. Thus in the Oregon beds we find that out of twenty-six determined species, ten are still living. With further examination this list will be probably increased. At the Texan and Mexican localities no recent species have been yet determined. As we enter the South American extension of the same fauna, the number of extinct species and genera greatly increases, although some recent species have been found associated with them in the Pampean Fauna.

I have found Indian implements in considerable numbers in such close proximity to the fossils of the Oregon Desert, as to lead to the strong suspicion that they are contemporary with the latter. This opinion has been, according to Mr. G. K. Gilbert, reduced to certainty by the finding of such implements in place in the Equus beds in Nevada or California. The age of the Equus beds is placed by Mr. Gilbert as Plistocene (Quaternary.)

THE NEIGHBORHOOD OF SEVILLE.—The city of Seville is situated in the alluvial plain of the Guadalquivir, which every few years, at the height of the winter rains, rises sufficiently high to flood the streets. On both sides of these alluvial flats is a pliocene area, rising into the clayey hills ; this is succeeded by a belt of miocene. To the southeast of the river, between it and the sea, are secondary rocks, among which the Nummulitic and Jurassic have been recognized. Between the folds of these rocks are intercalated series of more or less metamorphosed rocks, which were regarded by Sr. Macpherson as Triassic, but which Sr. Calderon, from the discovery of fossils still remaining in them, has proved to be altered Nummulitic or Jurassic strata, according to their position. On the opposite side of the river there exists a Triassic area, but the greater part of the formations are either Palæozoic or eruptive. Granites, gneiss, syenite, diorite, diabase, and porphyry cover extensive areas, there are patches of Carboniferous strata, and a considerable extent of Cambrian.

At Peñaflar, a few miles above Seville, the mountains (Sierra Morena) come near to the river, and in the hollows are deposits of gold-bearing clay, which is supposed to be derived from the diorite and diabase above, though it is mingled with material from the archaic limestone and mica-schists. A section at this spot shows the limestone interrupted by two broad bands of diorite, also with lines of phosphorites, a thin vein of magnetic iron, and two bands of mica-schists. Near the Guadalquivir there is a great fault, which brings the Miocene suddenly to the surface. The upper portion of the Miocene is conglomerate, the lower molasse. Two wide bands of amphibolite intersect the Miocene. On the south of the Guadal-

quivir a second fault, affecting only the Miocene, occurs.—*W. N. Lockington.*

An Attempt to Compute Geological Epochs.—The precession of equinoxes and the periodical change on the eccentricity of the terrestrial orbit are reflected on the geological series of strata, and are the key to the calculation of the duration of epochs.

The precession causes the winter and summer to be alternately longer and shorter. In the semiperiod when winter is longer than summer, the distinction between inland and coast climate becomes more prominent. The currents of the atmosphere become stronger, and in consequence of that, the ocean currents increase in strength, and that again reacts upon the climate. The periodical change of the climate produced by the precession is not great, but it is sufficient to imprint itself in the alternation of beds, and in the formation of beach-lines, terraces, series of moraines, etc. To each period of precession corresponds one alternation of strata.

The eccentricity of the Earth's orbit is periodically changeable.

Its mean value rises and falls for a period of about 1½ millions of years, with 16 oscillations. Such a rise and fall I term a cycle, and each cycle is, in the calculated curve, composed of 16 arcs.

The tidal wave, which is the most powerful agent in altering the sidereal day and in lengthening it, rises and falls in some measure with the eccentricity. It so exceeds the other forces that act in altering the length of the day, that the day steadily becomes lengthened, on the average, more quickly in the middle of the cycles, when the mean value of the eccentricity is greatest, and more slowly at the limit between them, when the eccentricity is the least; and in respect of the respective arcs with increasing speed during falling eccentricity.

The interior of the globe is plastic, owing to great pressure. The surface or "crust" opposes the greatest resistance to change of form. But according as the sidereal day becomes lengthened, and the equatorial regions of the earth increase in weight; a steadily increasing strain acts outward towards higher latitudes, and the strain increases until the resistance is overcome. We must also bear in mind that forces too slight to produce a sudden change in a solid body, may still produce a change of form when they act through long periods. Therefore the lengthening of the sidereal day acts not only on the seas, but also on the form of the solid globe. The earth approaches steadily more and more to the spheriform, but the solid crust is more sluggish in its movement than the seas, which immediately accommodate themselves to the altered time of rotation. As the motive force of these movements of seas and solid earth is periodically changeable, according to the eccentricity of the earth's orbit; these movements take place also, periodically quicker and slower. And as the seas always accommodate themselves to the forces before the dry land does, it is likely that the

beach-lines come to oscillate up and down once, for each rise and fall of the eccentricity of the earth's orbit. That is the case in respect of both the respective arcs of the curve and of the cycles. On such a cycle "the mean level of the sea" rises and falls once in 16 oscillations.

The sidereal day has (cfr. Damine) become several hours longer. It is therefore probable that there must have accumulated such a strain in the mass of earth, that a slight increase of strain would be sufficient to cause changes of form at the weakest points. It is also likely that those partial changes in the solid mass of the earth must occur, especially at times of great eccentricity, or some time after such an occurrence, when the motive force increases quickest.

The change in the tidal-wave, caused by the variation of the eccentricity, is presumed to be sufficiently great to explain the displacement of the beach-lines. A few metres of vertical displacement of the beach-line is sufficient to produce in the deep basins, an alteration of many metres of thick marine and fresh water beds. And as regards the changes in the solid body of the Earth, we must recollect that the series of beds is not complete at any single spot. In other words the oscillations were not general to such an extent that they were contemporaneous everywhere. Only by partial changes of form sometimes here, sometimes there, always at the weakest point in each age, has the solid earth approached to the spheriform. To each arc of the curve there corresponds, therefore, only a partial and not a general change in the form of the solid earth. And the oscillation of the beach-line, corresponding to the arc, can, therefore, not be pointed out everywhere, but only in the basins when the forces at that time exerted their effect. In this way we can obtain a perfect profile only by combining layers of all the Tertiary basins. Neither were the changes of the solid earth everywhere equal in extent, but were greatest at the weakest points of its surface, so that quite extensive local upheavals may be caused by slight changes in the length of the sidereal day.

That is the case as regards the individual oscillations, but even the great trangressions of the sea, of which one occurs in each cycle, need not be owing to any great rise of the sea level; as great flat lands may be covered and drained by a relatively small vertical displacement of the beach-line. But these great changes in the distribution of land and sea were undoubtedly sufficiently great to produce considerable changes of climate. Extensive seas in higher latitudes cause their climate to be mild, and vice versa.

If we now compare, keeping these principles in view, the curve of the eccentricity with the geological series of beds, we find an agreement indicating that the hypotheses are correct. The two cycles of the calculated curve, correspond to two geological cycles. Each of the cycles has 16 arcs that correspond to 16 slight oscillations of the beach-lines or 16 geological stages. In each of these stages there are as many alternations of strata as there are preces-

sions in the corresponding arc, and the mean sea level rises with the mean eccentricity in the middle of the cycles, and falls at the limit between them, and hand in hand with the mean sea level, rises and falls also, the temperature in the higher latitudes.

The doctrine here discussed agrees with Lyell's great principle. Slow changes in the length of the winter and summer and in the force of the tidal-wave, produce periodical changes of climate, and displacements of the beach-lines. The earth changes its form slowly and imperceptibly. The changes take place so slowly that the effects, first after expiration of many thousands of years, begin to appear distinctly. There are two astronomical periods which are the causes of the great and radical changes, of which geology leaves to us testimonies from remote ages, and which will still continue in the future, for millions of years to produce similar changes in the geography of the globe, its climate and its animal and vegetable life.—*A. Blytt in Christinia Videnkabs Selskabs Forhandlingar, 1889, No. 1.*

THE WESTERN SAHARA.—According to the data brought together by Sr. C. G. Toni, in the *L'Esplorazione Commerciale*, from the explorations of Spanish and German travelers, the western coast of Africa consists of a Cretaceous mass which is continued from the Cretaceous nucleus of Morocco and terminates at Cape Blanco. In immediate contact with the Cretaceous band of the coast and immediately above it, exists a thick deposit of desert sands, which covers all the subjacent formations. Beneath this sand through a large portion of its extent, rocks of the Devonian period are believed to extend and crop out in a few points. The hills of the oasis of Adrar Temar contain trachyte and have some peaks of granite and basalt. These hills also contain quartz, marble and various siliceous and ferrigenous rocks.

In the "Neues Jahrbuch für Mineralogie, Geologie und Paleontologie, Jahrgang, 1888, I Band; drittes Heft," Dr. Ferd. Roemer describes and figures a new genus of Echinodermata from Texas, to which he gives the name of "Macraster," and calls the only species *Macraster texanus*. This fossil has long been familiar to the writer in his stratigraphic investigations in Texas, and it makes a well defined horizon near the very top of the immense thickness of lower marine Cretaceous in Texas, and does not occur, as Dr. Roemer infers from the specimens which accompanied it to Germany, with the *Exogyra texana* fauna, a statement which has been verified by Mr. Geo. Stolly, the collector. This fact is important because of the tendency upon the part of European palæontologists to underestimate the value of the stratigraphic differentiation of the Texas Cretaceous. —*R. T. Hill.*

CÆNOZOIC.—Teeth of *Elephas antiquus* found at Rinconada, Cantillana and other places in the province of Seville Spain, to-

gether with vertebræ of the same species, are to be found in the museum at the University at the last named place, which museum also contains the mandibles of *Elephas armeniacus* found at Almudovar del Rio near Cordoba.

GEOLOGICAL NEWS.—GENERAL.—Herr Schlüter in two papers entitled "Ueber die regulären Echinodermata der Kreide Nord Americas," and "Ueber Inoceramus und Cephalopoden der Texanischen Kreide, (Niederrhein. Gesselschaft at Bonn, March, 1887), describes *Salenia mexicana*, from Chihuahua, Mexico, and *Inoceramus subquadratus*, *Turrillites irrideus*, and *T. varians* from Austin, Texas. The validity of the three species last mentioned is exceedingly doubtful, as the descriptions give no data sufficient to differentiate them from species already described by Roemer and Shumard. He also asserts that the Austin Cretaceous is equivalent to that of Ems, Germany, a rather indefinite statement since within the corporate limits of Austin is found nearly the whole range of the comprehensive Texas Cretaceous under conditions which could hardly be duplicated.—*R. T. Hill.*

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Messrs. Adams and Lawson [2] of the Canadian Geological Survey have been examining the rocks associated with the apatite in the Canadian apatite mines, to determine whether or not there is present a rock similar to the scapolite-diorite occurring in the Norwegian apatite region. They find that in some instances the Canadian apatite veins occur in a rock, composed essentially of orthoclase and biotite, with or without augite. i.e, either mica-syenite or augite-mica-syenite. None of the thin sections of the rocks associated with the apatite resemble in the least those of the Norwegian rock. At other regions in the Canadian Laurentian, however, associated with limestones and amphibolites, specimens were collected which are found to bear a strong likeness to the scapolite-rock from Norway. A specimen from near Arnprior on the River Ottawa, is described as a granular aggregate of augite, hornblende, scapolite, epidote, enstatite, pyrrhotite and rutile. The hornblende appears in some cases to be primary and in others to be secondary. The scapolite is in large colorless grains, many of which show polysynthetic twinning lamellæ, which may be due to the remains of the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Can. Rec. of Science, 1888, p. 185.

original plagioclase from which the scapolite was derived. Inclusions of dust and fluid cavities are present in the scapolite in large quantities and microlites are developed along its cleavage planes. The rutile occurs in grains closely associated with the scapolite. In several instances these grains appear to be made up of lamellæ, in which, however, there is no alternation of extinction as in the case of polysynthetic twins. The authors call the rock a scapolite-diorite. A rock from McDougall, Parry Sound District, contains a basic pagioclase in addition to the minerals mentioned above, and has been called plagioclase-scapolite-diorite. Schistose rocks with the composition of the last mentioned diorite, have had their schististy produced in them by pressure, as is evident from the shattered condition of the plagioclase constituent. The scapolite in these rocks bear no marks of a secondary origin from plagioclase. Augite is lacking, but biotite and quartz are observed in addition to the minerals found in the diorites.—The dolerites [1] of Londorf, Hessec, embrace coarse and fine grained varieties as well as glassy phases. The former consists of plagioclase, a titaniferous augite, olivine, a little enstatite, magnetites, apatite and titanic iron. The olivine is a pure hyalosiderite, elongated in the direction of the *c* axis, and intergrown with plates of titanic iron in such a way that these are perpendicular both to the cleavage planes and to the long axes of the olivine crystals. Amygadaloidal cavities contain the rock forming minerals together with little crystals of hornblende, and tridymite and masses of hyalite. To account for the existence here of well developed crystals of the minerals occurring in the body of the rock, Streng supposes the bubble of gas which gave rise to the cavity to have moved along through the partly solidified magma, shoving out of its way the liquid portions and leaving the crystals free. Other substances are supposed to be due to the alteration of the glass which was left attached to the crystals. The hornblende is regarded as having been deposited from the hot solutions, which would naturally circulate through the amygdaloidal cavities. The sublimation theory proposed to explain the existence of druse minerals in cavities of eruptive rocks he dismisses as unsubstantiated by facts. Upon the surface of the glassy dolerite is a crust of altered material with the characters of palagonite.—Lœwinson-Lessing [2] has embraced in a very readable article the views which are gradually becoming prevalent among petrographers in reference to the origin of diabases, gabbros and diorites. After briefly calling attention to the acknowledged differences between the structure of intrusive and effusive rocks, and emphasizing the peculiar features of the diabase structure, the author declares that this is the structure of an effusive rock rather than of an intrusive one. The association of diabases with fossil-bearing tuffs and their gradation into augite-porphyrites leads him to regard them as effusive under water, with the augite-porphy-

[1] Streng: Neues Jahrb. f. Min., etc. 1888. II. p. 181.
[2] Bull. Soc. Bélg. d. Géol. II. 1888, p. 82.

rites as their equivalent terrestrial effusives. The gabbros he acknowledges to be intrusive, and would regard as the intrusive equivalents of the diabases. In recapitulating his views the author divides the diabasic rocks into (1) intrusives (gabbros, granitoid-diabases), and (2) effusives, (*a*) terrestrial (augite-porphyrites and melaphyres), and (*b*) sub-marine (ophite-diabases). The diorites he would separate into those which are merely altered phases of diabase (including the epidiorites and the proterobases), and the primary diorites, which owe their hornblendic constituents to the presence of water vapor in the magma from which they solidified. Since hornblende is found only in those portions of rocks which cooled in the intratellurial period, *i. e.*, under such pressure as would prevent the escape of water, the diorites are to be looked upon as characteristic plutonic rocks.—The kersantite[1] dyke rocks from south-western East Thuringia contain numerous inclusions of granite which have been more or less affected by the enclosing rock. The quartz of the granite has been enlarged by the addition of new material, and has yielded tridymite as a product of its alteration. It contains numerous glass inclusions as the result of the fusion of original mica inclusions. Mica, augite and a new crystallization of feldspar have originated from the feldspar of the granitic rock. The original mica has changed into spinel and augite. Garnet, sillimanite, rutile, and apatite, which were among the original constituents of the granite can no longer be detected in the inclusion. The groundmass in which the new minerals lie consists of a micro-felsitic aggregate of quartz and feldspar, in which are numerous concentric and radial spherulites, and a well-marked fluidal structure. Inclusions of a mica schist, and of a cordierite bearing andalusite contact rock are also found in the same kersantite.—Mr. Cross[2] communicates some brief descriptions of a few of the eruptive rocks occurring in Custer Co., Colorado. The first rock described is a garnetiferous rhyolite with a eutaxitic structure. It is remarkable for its simple composition which is as follows:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5
75.20	12.96	.37	.27	.03	.29	.12	8.38	2.02	.58	tr.=100.22.

A sanidine-oligoclase-trachyte possesses the peculiarity of a secondary porous structure due probably to the alteration of inclusions. Its biotite has yielded augite on its corroded edges. In a syenite occurring in narrow dykes are irregularly-shaped pieces of biotite, with their greatest development in the direction of their *c* axes. Peridotite and an olivine-augite-diorite are also described. The former contains brown hornblende and hypersthene in about equal proportions.—The same writer[3] announces the discovery of a second occurrence of phonolite in the United States. The specimen examin-

[1] R. Pohlmann: Neues Jahrb. f. Min., etc. 1888. II. p. 87.
[2] Proc. Col. Scient. Soc. 1887. p. 228.
[3] Proc. Col. Scient. Soc. 1887. p. 167.

ed was not found in place. It was picked up on the Eastern slope of the Hayden divide, between Florissant and Manitou, Colorado. The rock consists of about 25 per cent. of nepheline, of granular sanidine, prismatic particles of a deep green hornblende, and little colorless grains of a mineral supposed to be augite.—After an examination of the specimen of altered diabase from Quinnesec, Mich., Cathrein [1] concludes that the rutile, which Williams [2] thought to be secondary after ilmenite contains no titanium, and can, therefore, not have given rise to the rutile by alteration.—A porphyritic hornblende—andesite from Dewéboyun in Turkey in Asia, is described by Lœwinson-Lessing[3] as composed by large crystals of hornblende and labradorite in a groundmass consisting of plagioclase microlites in a glassy base.—Karl Schneider [4] has observed the alteration of sphene into calcite and perofskite in a phonolite from Bohemia.

Mineralogical News.—*New Minerals, Sperrylite*[5] is the first compound of platinum that has been found as a mineral. It occurs in the Vermillion mine, in Algoma, Ontario, in a layer of loose material on the contact between a vein of gold-bearing quartz and the enclosing rock, and in pockets in the decomposed ore. In both cases it is associated with copper and iron pyrites. The sperrylite is found in small lustrous grains, which are fragments of crystals on which Mr. Penfield has discovered cubic, dodecahedral, octahedral, and pyritoid faces. The color of the fragments is tin-white and their powder black. Their hardnesss is between 6 and 7. Although their specific gravity is 10.602 the grains have a tendency to float upon the surface of water. Analysis yielded :

As	Sb	Pt	Rh	Pd	Fe	SnO_2
40.98	0.50	52.57	.72	tr.	.07	4.62

corresponding to $PtAs_2$, after allowing for the cassiterite present as an impurity. The artificial compound made by passing vapor of arsenic over red hot platinum possesses many of the properties of the natural substance, the most characteristic of which is instant fusion upon contact with red hot platinum, with the evolution of almost odorless fumes of arsenic, and the production of porous excrescences of the color of platinum. The composition of the mineral and its crystallization relegate it to the pyrite group.—Attention has already been called to the new mineral[6] Beryllonite. A full description of its occurrence and properties has recently been given by Messrs. E. S. Dana and Wells.[7] The mineral is found at the

[1] Neues Jahrb. f. Min., etc. 1888. II. p. 151.
[2] Amer. Naturalist. Feb. 1888. p. 168.
[3] Bull. Soc. Bélg. d. Géol. 1887. I. p. 110.
[4] Neues Jahrb. f. Min., 1889, I. p. 99.
[5] Amer. Jour. Sci., Jan. 1889, p. 71.
[6] Amer. Naturalist, Nov. 1888, p, 1023.
[7] Amer. Jour. Sci., Jan., 1889, p, 23.

base of the McKean mountain near Stoneham, Maine, in the destritus of what is supposed to be a granitic vein in mica schist. In addition to the facts announced in the former notice it may be added that the mineral is orthorhombic with $a : b : c = .5724 : 1 : .5490$. It has four cleavages parallel respectively to o P, ∞ $\bar{P}\bar{\infty}$, ∞ $\breve{P}3$ and ∞ $\breve{P}\breve{\infty}$ in the order of their perfection. Twins parallel to ∞ P are not rare. It is colorless or yellow and transparent. The plane of its optical axes is ∞ $\bar{P}\bar{\infty}$. Its double refraction in negative and $2 Ha = 72° 47'$ for yellow light. The mineral is remarkable for the presence in it of cavities elongated parallel to the *c* axis. These sometimes contain two movable bubbles, and are so numerous as to produce an apparent columnar structure in the mineral.—*Dahlite* from Bamle, Norway, is described by Brögger and Bäckström[1] as a new mineral occurring as a thin yellow crust on massive apatite. This crust is composed of little fibres arranged perpendicular to its surface, which is smooth and lustrous. The mineral is translucent, is optically negative, has a hardness of about 5 and a specific gravity of 3.053. It is a hydrous double phosphate and carbonate of calcium ($4 Ca_3 (PO_4)_2 + 2 Ca CO_3 + H_2O$) It gave on analysis :

P_2O_5	CO_2	CaO	FeO	Na_2O	K_2O	H_2O
38.44	6.29	53.00	.79	.89	.11	1.37

Awaruite[2] is the first nickel-iron compound described that is not of meteoric origin. It occurs in small plates and granules in the sand of George River, in the western part of South Island, New Zealand. Its composition is :

Ni	Co	Fe	S	Si
67.63	.70	31.02	.22	.43

The mother rock of the mineral is a serpentine that has originated from an olivine rock by alteration.— Darapsky[3] adds *Naposite* to the list of iron sulphates from Atacama, Chili. It is found in radially fibrous, glistening, brittle, dark-red crystals containing 24.72 per cent. of SO_3, 30 per cent. of Fe_2O_3, and 16.43 per cent. of H^2O, thus corresponding to the formula Fe (FeO_3 SG 43, + 10 H_2O It is decomposed by water and by acids.—*Mazapilite*. Dr. König[3] announces the discovery of a new arsenide of calcium and iron from Zacatecas, Mexico. It occurs in dark red and black, probably orthorhombic crystals, with a hardness of 7 and a specific gravity of 3.567.

MISCELLANEOUS.—Gonnard[4] describes natural corrosion figures in *Barite* from the Puy-de-Dôme, that consist of little depressions

[1] Aefv. Vet.—Akad. Förhandl, 1888, d. 493. Ref. Am. Jour. Sci. Jan. '89, p. 77.

[2] Vom Rath: Ref. Neues Jahrb. f. Min., etc., 1889, I. p. 23.

[3] Boletin d. l. Soc. Nac. Min., Santiago de Chile, Ref. Neues Jahrb, f. Min, 1889, I p. 33.

[4] Bull Soc. Fr. d. Min., 1888, XI., p. 269.

with an orthorhombic or a monoclinic symmetry. Those of the latter kind are triangular in shape and are supposed to owe their abnormal symmetry to twinning.—Mr. Cross[1] has noticed striations in the cubic faces of *galena* from the Minnie Moore mine, Bellevue, Idaho, which he believes to be due to twinning lamellæ produced by the slipping of alternate bands of the mineral along gliding planes, as a consequence of pressure. The twinning planes lie in the zone between ∞O ∞ and ∞O—New methods for the detection of tin, caesium, and rubidium under the microscope are suggested by Streng[2] The detection of tin depends upon the fact that KCe and Sn Ce yield a double salt, which crystallizes in little tabular orthorhombic crystals, which upon the addition of nitric acid pass over into octahedroas modified by icositetrahedrons. Caesium and rubidium chlorides with stannous chloride in hyrochloride acid solutions give crystals of the same shape as those of potassium and stannous chlorides, but in the case of caessium these are brightly polarizing, while in the case of rubidium they are monoclinic. The author also calls attention to the fact that all hydrofluoric acid sold as pure, even when carefully made from cryolite, contains silica and cannot be used for the detection of this substance in small quantities.—Calcium carbonate readily decomposes solutions of aluminium salts in the cold, with precipitation of gelatinous aluminium hydroxide, which, in the presence of coloring matters absorbs these and becomes stained, Under the same conditions dolomite produces no change in the solutions unless it remains in contact with them for a long time. A knowledge of these facts induces Lemberg[3] to propose a method of distinguishing between calcite and dolomite in thin sections of rocks. The solution which he proposes for use is made by dissolving four parts of dry aluminium chloride in sixty parts of water and adding to it six parts of *haematoxylin campechianum*,

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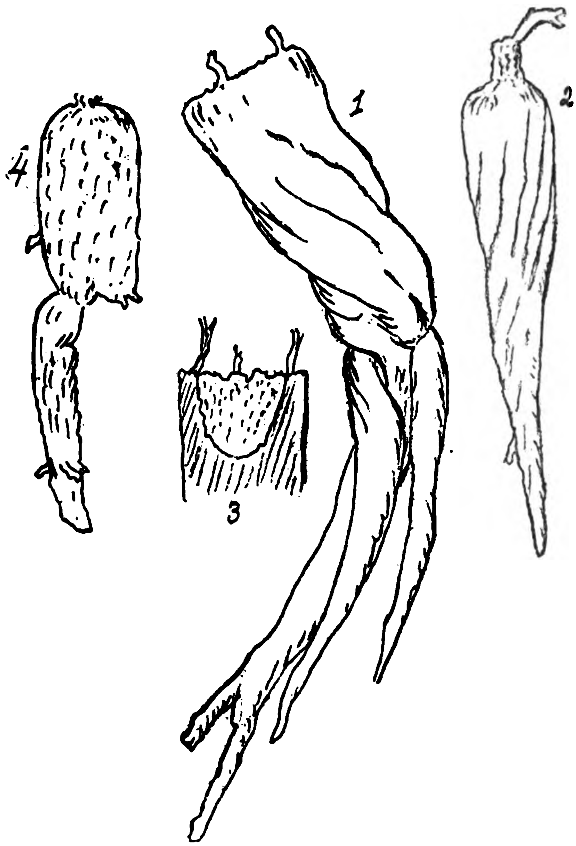
BOTANY.[4]

TWO BIG-ROOTED PLANTS OF THE PLAINS.—Now and then some of the plants of the plains present odd characteristics not observed in some of the eastern regions. Two species native of the open plains at an altitude of from 2,000 feet above the sea to the base of the Rocky Mountains are remarkable for their enormous roots. One

1 Proc. Col. Scient. Soc. 1887, p. 171.
2 Neues Jahrb. f. Min., etc., 1888, II., p. 142.
3 Zeits. d. deuts. geol. Gesell. XL., 1888, p. 357.
4 Edited by Chas. E. Bessey, Lincoln, Nebraska.

of these is the Wild Pumpkin (*Cucurbitale perennis* Gray), which produces a trailing stem, bearing triangular, woolly pubescent leaves, whose blades are six to eight inches in length. The fruits are about the size of an orange, and are perfectly spherical in shape. When ripe they are yellow with some greenish longitudinal markings. Internally they are exceedingly fibrous, and contain a great number of seeds (about 200) which are about one-third of an inch in length



But the root is the remarkable part of the plant. Two specimens were brought to my laboratory last fall, figures of which are given herewith. The largest (Fig. 1) measured when first dug nearly seven feet in length, and at the top or crown had a diameter of fully eleven inches. The crown is curiously hollowed out, as shown in Fig. 3, the cavity being fully six inches in depth. The inside of the cavity

is covered with a healthy cortex, and there is no sign of decay about it. Around the margin of the cavity are the remains of several stems, showing that in this portion the buds for the annual running stems occur. At about two feet from the crown the root bends abruptly and sends out a couple of branches. When in the ground the part below the bend was vertical, while that above was inclined. The root grew upon a hillside and its upper portion was nearly if not quite perpendicular to the surface of the ground. The bend was probably occasioned by the slow sliding of the upper strata of the soil down the hill. The branches are much smaller where they emerge from the main root, and enlarge considerably within the first six or eight inches.

The smaller root (Fig. 2) measured when taken from the ground nearly four feet in length, and had a diameter of about eight inches. It is regular in form, and is not much branched. Its crown is extended into a neck five or six inches long, and upon the upper part of this are the remains of the branching stems.

Both roots are very fibrous internally, almost woody in fact, but they contain also an enormous amount of stored up nourishment for the rapid development of the annual stems. The first (1) weighed eighty pounds when fresh, and the second (2) thirty-three. But this store of nourishment is amply protected against the hungry gophers, moles, mice, rabbits, squirrels and larger animals, for it is intensely bitter. In the struggle for existence those only have remained whose bitterness was sufficient to overcome the hunger and thirst of the animals of the plains.

The second big-rooted plant is the Wild Morning Glory (*Ipomœa leptophylla* Torr), a beautiful plant of a bushy habit, bearing numerous large pink-purple flowers closely resembling those of the common cultivated Morning Glory of the gardens. The stems are numerous and branching, but not twining, and they rarely attain a height of more than a couple of feet.

The root is enormous, often approaching the size of that of the Wild Pumpkin. A specimen in my laboratory is shown in Fig. 4. It is nearly three feet in length, and evidently was originally much larger, and has a diameter of eight inches. As may be seen, it branches at about fifteen or sixteen inches from the top. On the one side there were originally several branches, but on the other but one. This shows, also, the peculiarity noticed above of the smaller size of the branch root at the point of its origin, and its subsequent enlargement.

Both of these plants come down upon the plains to about the 100th meridian. In northern Nebraska at Long Pine, I have seen the Wild Morning Glory ten or twelve miles east of that meridian. The wild pumpkins are abundant in Lincoln County (south of the Platte River), not more than fifteen or eighteen miles west of the line mentioned.—*Charles E. Bessey.*

Herbarium Notes.—An Alphabetical Arrangement.—In arranging an herbarium one's first thought would be to arrange it according to some recognized natural system of which it would then constitute a practical application. Yet,as herbara are intended much more for use in the identification of species than for instruction in systematic botany or for embodiment of ephemeral classifications, alphabetical arrangements based on assumed convenience are probably the prevailing ones. These alphabetical arrangements may be either of species in a genus or of genera in certain large groups, as the Fungi, the composite or the Grasses; but they are all based on the idea of convenience of reference.

As to the alphabetical arrangement of genera. Without considering the question whether a natural arrangement, even if slightly less convenient, would not be preferable, I believe that such an arrangement can be shown to be equally convenient. In the first place the largest families of Fungi, for example, as the Icaceæ, Uredineæ, or Sphæriaceæ; are by no means as large as A, C, S, or P of an alphabetical arrangement. The larger groups like S and P are exceedingly inconvenient unless subdivided; and surely it is of more value to the student to know the subdivisions of the Sphæriaceæ than of S, unless he is preparing himself to be a Register of Deeds. The convenience of an alphabetical arrangement arises from the familiarity of the alphabet, yet the names of the natural sub-divisions of plants should be scarcely less familiar to the botanist. Then, too, allied genera are often wanted at the same time; genera of the same initial letter probably never. Plants are generally studied in small groups; and nothing could be more inconvenient to the student of a tribe than to find six genera in six distinct groups, each of which must be carefully searched, nor more convenient than to have them together, perhaps even placed in the very order in which he wishes to study them.

Somewhat more can be said in favor of an alphabetical arrangement of species in a genus. Such an arrangement is not needed to any appreciable extent, however, except in very large genera. Yet in such genera as Carex, for example, a natural arrangement is equally convenient, without regarding the fact that it is infinitely more instructive. Almost any one who has spent much time in the matter can put a Carex into the proper group, the species within the group is the difficulty; and it is much more convenient to have all the species of a group together than to be forced to search through five or six letters. But in genera of Fungi, as Cercospora, where there is no very good natural arrangement, it might be said, is better than one based on the host, such as is usually given in the books, because neither is particularly instructive and the first is the handier. Yet, as herbarium specimens are consulted for the most part in connection with a manual, an arrangement following it would certainly be perfectly convenient. And, perhaps, it would not trouble the student over much to remember that Cercospora viticola is on the

grape and therefore, goes in the section "in Di cotyledonis lignosis," while he could gain very little from the reflection that its specific name begins with "J."

THE ALGÆ FUNGI AND LICHENS.—Many who no longer hold the idea of the autonomy of the groups Fungi, Algæ, and Lichens, nevertheless persist in keeping them separate in the herbarium. This, too, is done on the plea of convenience, as they are usually studied by different students. Letting alone the question of whether it would not be better for the mycologist to think more about Algæ, I believe that an herbarium where all plants are arranged according to a natural system without regard to anything else is perfectly convenient for reference, as long as the families are clearly indicated on the cases. If this is so, the natural arrangement is clearly preferable. For these are not mere questions of convenience. In the case of a classification, if mere convenience of placing specimens in their proper genera and species were all that was to be considered, perhaps no system would be superior to the celebrated one of Linnæus But this is one of the last things which we demand of a classification. The function of a classification is to teach us the relations, the ancestry and thus a part, it may be, of the history of plants. So with an herbarium. Its object should be no more to furnish authentic specimens for the determination of single species than the higher one of teaching us the relations of these species by bringing together their names.—*Roscoe Pound.*

SACCARDO'S GREAT WORK ON FUNGI.—Although Saccardo's Sylloge Fungorum has been noticed in the NATURALIST from time to time upon the appearance of the volumes, it may be of service to our readers to indicate more fully the scope of the great work. The intention of the author (Professor P. A. Saccardo of the University of Padua) is to publish in one work the descriptions of all the Fungi now known in all parts of the world. Such an undertaking involves as all will admit, an immense amount of labor, and he must have been a bold man indeed who willingly entered upon it. As a matter of course such a work, intended for the whole world, could be written in Latin only.

The first volume appeared in 1882, the second in 1883, the third in 1884, the fourth in 1886. In the latter year A. N. Berlese and P. Volgins brought out a supplementary volume to volumes I to IV, in which additions and corrections were made. The fifth volume appeared in 1887, and the sixth and seventh in 1888. The eighth and concluding volume may be looked for some time during the present year. The total number of pages thus far printed is 6898, and doubtless the final volume will bring the number up to 7700.

The system adopted by Saccardo may be learned from the following synopsis:

ORDER PYRENOMYCETEÆ Fr. Em. De Nat.
Family 1. *Perisporiceæ* Fr.
" 2. *Sphaeriaceæ* Fr.
" 3. *Hypocreaceæ* De Nat.
" 4. *Dothideaceæ* Nits. et Fkl.
" 5. *Microthyriaceæ* Sacc.
" 6. *Lophiostomaceæ* Sacc.
" 7. *Hysteriaceæ* Corda.
ORDER SPHŒROPSIDEÆ Lev. reform.
Family 1. *Sphæroideæ* Sacc.
" 2. *Nectroideæ* Sacc.
" 3. *Leptostromaceæ* Sacc.
" 4. *Excipulaceæ* Sacc.
ORDER MELANCONIEÆ Berk.
Including six "Sections" which are designated Hyalosporeæ, Scaloce-allantosporeæ, Phæosporæ, Didymosporeæ, Phragmosporeæ
ORDER HYPHOMYCETEÆ Martins.
Family 1. *Mucedineæ* Link emend.
" 2. *Dematieæ* Fr.
" 3. *Stilbeæ* Fr.
" 4. *Tubercularieæ* Ehrenb. emend.
ORDER HYMENOMYCETEÆ Fr.
Family 1. *Agaricineæ* Fr.
" 2. *Polyporeæ* Fr.
" 3. *Hydneæ* Fr.
" 4. *Theleporeæ* Pers.
" 5. *Clavarieæ* Corda.
" 6. *Tremellineæ* Fr.
ORDER GASTEROMYCETEÆ Wild.
Family 1. *Phalloideæ*, Fr.
" 2. *Nidulariieceæ* Fr.
" 3. *Lycoperdaceæ* Ehreub.
" 4. *Hymenogastraceæ* Vttt.
ORDER PHYCOMYCETEÆ DeBary.
Family 1. *Mucoraceæ* DeBary.
" 2. *Peronosporaceæ* DeBary.
" 3. *Saprolegniaceæ* DeBary.
" 4. *Entomophthoraceæ* Fowakow.
" 5. *Chytridiaceæ* D. By eb. Worou.
" 6. *Protomycetaceæ* DeBary.
COHORT MYXOMYCETEÆ Wallr.
Subcohort I. **Myxomyceteae** (Grauinæ)
ORDER PROTODERMIALLŒ Rost.
Family 1. *Protodermiaceæ* Rost.
ORDER CALCAREÆ Rost.
Family 1. *Cienkowskiaceæ* Rost.
" 2. *Physaioceæ* Rost.
" 3. *Didymiaceæ* Rost.
" 4. *Spumariaceæ* Rost.
ORDER AMAUROCHETEÆ Rost.
Family 1. *Echinosteliaceæ* Rost.
" 2. *Stemonitaceæ* Bel.
" 3. *Raciborskiaceæ* Bel.

" 4. *Amaurochaetaceæ* Rost.
" 5. *Brefeldiaceæ* Rost.
" 6. *Enerthenemaceæ* Rost.

ORDER ANEMEÆ Rost.
Family 1. *Liceaceæ* Rost.
" 2. *Clathroptychiaceæ* Rost.

ORDER HETERODERMEÆ Rost.
Family 1. *Cribrariaceæ* Rost.

ORDER COLUMELLIFERÆ Rost.
Family 1. *Riticalariaceæ* Rost.

ORDER CALONEMEÆ Rost.
Family 1. *Perichaenaceæ* Rost.
" 2. *Arcpriaceæ* Rost.
" 3. *Trichiaciæ* Rost.

Appendix. ORDER SOROPHOREÆ Zoph.
Family 1. *Guttubineæ* Zoph.
" 2. *Dictyosteliaceæ* Rost.

Sub Cohort II. **Monadineae** Cienk.

ORDER MONADINEÆ AZOOSPOREÆ Zopf.
Family 1. *Vampyrelleæ* Zopf.
" 2. *Burrsullineæ* Zopf.
" 3. *Monocystaceæ* Zopf.

ORDER MONODINEÆ ZOOSPOREÆ Zopf.
Family 1. *Pseudosporeæ* Zopf.
" 2. *Gymnococcaceæ* Zopf.
" 3. *Plasmodiodiophordæ* Zopf.

ORDER USTILAGINEÆ Tul.

Artificially divided into "Amerosporeæ" "Didymosporeæ" and "Dictyosporeæ."

ORDER UREDINEÆ Brongn.

Artificially divided into "Amerosporeæ" "Didymosporeæ" and "Dictyosporeæ."

The final volume will contain the Discomyceteæ, Tuberaceæ and Satrigomyceteæ, and the whole work will then be one which every student of the Fungi will need to have. The descriptions, while often mere translations or copies of the originals, are in the case of the species of certain groups entirely re-written. The total cost of the whole work will be about one hundred dollars.—*Charles E. Bessey.*

ZOOLOGY.

TWO REMARKABLE RADIATES.—In the *Aarsberetning* of the Bergen Museum for 1887 (but recently issued), Dr. D. C. Danielssen describes two interesting forms obtained by the dredge in the recent Norse North Atlantic Expedition. When collected they were

regarded as sea anemones allied to Halcampa an l Cerianthus, but anatomical investigation shows them to differ from all Cœlenterates in just that feature which has been regarded as diagnostic of the group, while on the other hand they have many points in common with the actinians. For them Dr. Danielssen has made the Tribe Aegireæ which he defines as "Actinida, with a perfect body cavity (Cœlom) and a developed digestive apparatus consisting of œsophagus, stomach and anus." The two genus are called Fenja and Aegir, names derived from Scandinavian mythology. In general terms they may be described as sea anemones whose so-called stomach (Actinostom of Agassiz) has extended down to the base thus partially (Aegir) or completely (Fenja) separating the digestive from the mesenterical spaces, while in both an anus is developed in the base. In both the cœlome thus formed is divided by twelve perfect septa, but in Aegir these spaces communicate by twelve slender fissures with the rectal area of the digestive tract. In Fenja there are twelve genital pores around the anus, outside the rectum; in Aegir the genitalia are more like those of ordinary sea anemones. Both forms are hermaphrodites.

As will be seen these forms which in every other respect are true sea anemones differ from all cœlenterates in the distinction between digestive and cœlomic cavities. On the other hand they differ from the true Cœlomata in the fact that each cœlomatic space extends the length of the body. While interesting, in a general way, as indicating a possible development of the cœloma of higher animals from the mesenterical space of an actinian, we cannot regard them as being links in the line connecting the Cœlenterata with segmented animals, according to the theories of Balfour and Sedgwick, for that demands the conversion of the cœlenterate mouth into mouth and anus, while the anus of Aegireae is clearly not derived in this way, but is rather a perforation through the base of attachment of the ordinary sea anemone. Occasionally such "anal pores" occur in the Cerianthidæ. An extensive account illustrated by over twenty plates is promised at an early date.

THE EYES OF TRILOBITES.—Mr. J. M. Clarke gives an account of the eyes of the trilobite *Phacops rana* in the *Journal of Morphology*, Vol. II., 1888. He divides the trilobites into two groups, Holochroal and Schizochroal, according as the *external* surface of the cornea is faceted or not. The Phacopidæ belong to the latter group, and their eyes are to be regarded as aggregate rather than compound. The corneal lenses were hollow or filled with some substance different from the cornea. Nothing like a crystalline cone has been preserved. Until maturity the number of eyes in an optical organ increases by the addition of new lenses at the ends of the diagonal rows, and these new lenses are apparently formed by a thinning of the integument. (The reporter would remark that there seems to be a difference in the way in which, according to Mr

Clarke's observations, the visual area is increased in the trilobites and that shown by Mr. Watase's unpublished observations on the eyes of Limulus.) After maturity, although the trilobite may continue to increase in size, senility begins and with it there is a decrease in the number of optical elements.

In a concluding note Mr. Clarke calls attention to the fact that in the Leptostracan genus Mesothyra of the Portage (Devonian) group "the eye consists of a single deep pit at the summit of the optic node."

THE SEXES OF MYXINE.—Dr. Fridtjof Nansen (Bergens Museum's *Aarsberetning*, 1887) states that in his studies of the nervous system of Myxine he was struck by the fact that it semed as if females only came under review. He therefore investigated the subject, and after reviewing the more prominent papers and detailing his own investigations states his conclusions that "Myxine is generally or always (?), in its young state, a male; whilst at a more advanced stage it becomes transformed into a female." The genital organs are female in front and male behind. Nansen has investigated the spermatogenesis but his results are widely at variance with those of Cunningham. He has also tried, but in vain, to obtain the embryology of this form. Myxine is extremely abundant at Bergen, but dredging in the harbor at all seasons of the year has failed to produce a single ovum. He has tried to breed them in confinement but though gravid females were kept in wooden cages for half a year they obstinately refused to lay their eggs. From his studies of ovaries he concluded that eggs were deposited at all seasons of the year, and he adds to our knowledge of specimens of the eggs of Myxine by recording one dredged in 1857 by Dr. Danielssen and his son near Molde. Nansen does not seem to be familiar with a paper by Putman on Myxine and Bdellostoma in the *Proceedings* of the Boston Society of Natural History some years ago.

ZOOLOGICAL NEWS.—PROTOZOA.—Mr. Beddard, in his earthworm studies, has recently met (Proc. Zool. Soc., London, 1888, p. 355) a gregarine in the body cavity of a New Zealand Perichæta which is remarkable among gregarines in forming a nucleated cyst.

Dr. L. Plate (*Zool. Jahrbuch*, III., 1888) describes under the name Acinetoides a new infusorian, of which two species were found at Naples, which seems to connect the Acinetæ and Ciliata. It bears a clubbed suctorial thread for taking food, which is shorter and stiffer than those in the true Acinete ; and it possesses besides longitudinal rows of cilia on the ventral surface. Acinetoides forms colonies and has been seen to divide transversely.

CŒLENTERATA.—Gireg describes and figures as new (Bergens Museum's *Aarsberetning* for 1887) *Rhizoxenia alba* and *Sympodium margaritaceum* from the Norwegian coast.

EMBRYOLOGY.[1]

The Structure of the Human Spermatozoon.—Any new light which is thrown upon the structure of the sexual elements by the aid of more refined methods of research, will be welcomed in view of the possible bearings which such information may have upon questions of inheritance. That variations in the structure of the male elements do occur as abnormalities seems to be established by the researches of E. M. Nelson [2], who finds that not only do they vary in the number of heads, but also in the number of tails and even as to the number of the nuclei; forms were also met with which were joined together in pairs by a band. Those familiar with Selenka's work on the Opossum will recall in this connection the singular fact recorded by that embryologist as to the double nature of the fresh spermatozoa of *Didelphys virginiana*.

The most interesting facts, however, which Mr. Nelson records as the result of his studies, with the aid of the new apochromatic objectives of Zeiss, relate to the details of structure of the human male element.

The head, which has always been figured as a simple, somewhat flattened pyriform body, according to this last observer, is rather complex when studied by the aid of better appliances. It is rather obovate in outline from the broad side, but when viewed edgewise it is seen to be curved upon itself, so that it bears a resemblance to an oblong meniscus lens.

Furthermore, this observer gives names to its parts. The anterior portion containing the nucleus, he calls the *spore*, and at its extreme anterior pole it bears an excessively minute *filament* as he names it, which is hardly as long as the spore itself. He suggests that this is a sort of feeler or tentacle by means of which the spermatozoon finds its way into the pore in the ovum which serves for the micropyle.

The flattened and curved flagellum-bearing spore is joined to or rests in what Nelson calls the *cup* which corresponds to the swollen basal part of the head as usually figured.

Then succeeds a delicate cycle of processes just around the base of the cup where the latter joins what Nelson calls the *stem*, which answers to the "middle piece" of authors. This delicate cycle of bluntly rounded processes he calls the *calyx*.

Next follows the *stem* or "middle piece" which at its posterior extremity is slightly swollen. This swollen posterior extremity of the stem and the anterior end of the tail there occurs a constriction which has been previously noticed by Nelson, and to which he gives

[1] Edited by Prof. John A. Ryder, University of Pennsylvania, Philadelphia.

[2] On the human spermatozoon, Journ. Quekett Microscop. Club. Ser. II, Vol. III, No. 23. Jan., 1889, pp. 310-314.

the appropriate name of *joint*. It seems, in fact, as if such were its nature, as a very short refringent and dark band of substance here joins the stem and tail together. This band is so much narrower than the stem or tail that it appears as if there were a deep notch on either side of the tail portion of the spermatozoon at this point.

Immediately behind the joint, the flagelliform tail is continued as that tapering organ[1] familiar to all histologists since the time of Leeuwenhoek.

The structure of the spermatozoon is therefore more complex than is usually supposed, and the following eight parts may be distinguished, beginning at the anterior extremity :

Filament, spore, cup, calyx, stem, joint, tail.

The following measurements are given :

Head (spore and cup) long	$\frac{1}{4250}$	in.	5.9	μ
" " broad	$\frac{1}{7500}$	"	3.4	μ
Stem long	$\frac{1}{5700}$	"	4.4	μ
Tail from joint to tip	$\frac{1}{500}$	"	.05	*mm.*
Total, head, stem and tail	$\frac{1}{425}$	"	.06	*mm.*

From what has preceded it is clear that there is great capacity for variation. Further, it is probable that this high degree of complexity signifies that a very considerable part of the spermatozoon is of secondary importance, or is rather only accessory to the act of fertilization or the formation of an öosperm. The already remarkable results of those investigators who have occupied themselves with the study of the phenomena of fertilization, must undoubtedly be modified when the subject is viewed from the basis of a renewed study of the structure and function of the spermatozoon at all phases of the process of its union with the ovum. May it not be that some important parts of the process of union have escaped observation in virtue of the optical difficulties which are involved? The consequences of fertilization as the result of union with abnormal spermatozoa is also worthy of consideration, not only from a purely scientific standpoint, but also on account of the possible light it might throw upon possible abnormalities so provoked, which eventuate in disease and deformity. Truly, to those who are familiar with the great number of forms assumed by the male element throughout the animal kingdom, and the very diverse conditions under which fertilization occurs, it seems as if Du Bois Reymond's reproach—*Ignorabimus*—may here remain true.

[1] It may possibly be of advantage to use the word *organula* here instead of organ, following a suggestion of Möbius. Functionally differentiated multicellular aggregates in multicellular forms or metazoa are in this sense organs, while for functionally differentiated portions of unicellular organisms or for such differentiated portions of the unicellular germ-elements of metazoa the diminutive—*organula*—is appropriate.

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

MOUND AND OTHER EXPLORATIONS BY MR. WARREN K. MOOREHEAD.—On the high wooded hills bordering the Little Miami River in central Greene County are a number of mounds. One is the large mound on the farm of Mr. J. B. Lucas, three miles west of Xenia. Up to June, 1885, this mound had never been thoroughly explored. It was about twenty feet in height with a slightly flattened summit, perhaps seven feet across, and sixty feet in diameter at the base. Four good sized trees grew out of the sides, one of which was an oak perhaps ninety years old.

This mound was opened in June, 1885. A shaft was sunk, from the summit downwards, twelve feet, but nothing of interest found. We began a trench on the outer edge of the east side, and carried it to the center; then extended the trench from the summit down until these two met. Completing this work, we caved in the sides, and threw back the earth taken out, thus restoring the mound nearly to its former shape.

The trench from the outer edge of the mound to the center was about twenty-five feet in length. For the first ten feet of this distance the earth was fine clay, not mixed with ashes. At twelve feet from the outer circumference was a bed of ashes and charcoal, perhaps two feet in thickness, and sticks of the half-charred wood three feet long and quite well preserved were taken out. These had been laid with regularity and were probably covered with earth before the fire had consumed them. At sixteen feet a thin irregular stratum of ordinary river sand was found, three or four inches in thickness.

Immediately following this sand layer, and extending upwards possibly three feet, was a mass of hard, burned clay. When this was reached we stopped work in the trench and went to the shaft above. We had not thrown out a foot of earth until we came to a mass of charcoal and ashes. This occurred without intermission for two feet or more when we came upon a layer of pure clay, nearly two feet in thickness. Immediately below this was the thin stratum of sand, and under this sand, resting on the "altar" of burnt clay, were five skeletons much decomposed. Of these, the teeth and small fragments of the skull and short sections of the femur and tibia were all that could be preserved. The skeletons were buried side by side; the heads to the south. At the feet were fragments of a clay urn, peculiarly shaped. It had been broken into seven or eight pieces, but could be easily restored. It was of the "basket-moulded" pattern, having plain marks of the basket reeds

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

on the surface—a pattern rare in Ohio. Save a few perforated bear teeth and three rough spear-heads, no other relics were found. The excavation from both summit and base were carried through the burnt clay to the original level below. The clay contained fragments of calcined bones evidently of animals such as the deer, bear, and raccoon.

The opposite side of the mound (the west side) has since been opened by parties living near, but nothing found.

Two Indian Cemeteries near Romney, Hampshire County, W. Va.—Eight miles up the south fork of the Potomac River from Romney, W. Va., is an island owned by Mr. I. Pancake, and on this island once stood a large Indian village. A flood some two years ago cut a channel through the island and exposed to view the skeletons of many human beings, as well as relics and objects of aboriginal manufacture. Recent newspaper reports attracted Mr. Moorehead's attention, and he visited the spot for the purpose of investigation.

With a force of several Irishmen, work was commenced the morning of January 16 '89 A large part of the island was carefully dug over and the earth examined to a depth of four feet. It was found that over one-half of the bodies originally interred had been washed out by the flood ; those that remained were scarcely two feet below the surface, consequently when the island was cultivated the bones would be much disturbed. Only five skeletons could be taken out entire, those at a depth of three feet. With two of them were buried several triangular arrow-heads, a clay pot, whole, (not decorated) and fragmentary bones of deer, ground hog, and turtle. With the others nothing was found. On the surface of this island we picked up many beads, arrow-heads, broken pottery, split bones, carved bones, unfinished celts, etc. The space occupied by the evidences of Indian occupation was about 150x200 yards. The most interesting find met with during the excavation of these graves was the discovery of a large ash pit, about six by seven feet, five feet in depth. In this there were many deer bones, broken pottery, ashes, charcoal, etc. There was no order observed, the accumulation seemed to result from a hearth or wigwam. The only object found in the pit was a long sharp bone awl, a fine specimen. A part of a skeleton (said by some to be Ox, by others Bison) was taken from the bottom of this pit. The bones showed action of fire, and many of them were broken into fragments.

Two days were spent in examining another village site, on the north sideof the river twelve miles below. This was smaller than the one above mentioned, but as it had been little disturbed we found more skeletons, etc. This site does not exceed 200x450 feet. In a space of 60x100 feet we took out fifteen skeletons in a fairly good state of preservation. All were buried singly and extended, save

four. These four were heaped together; the skull of one was missing, the arms of another gone, and the leg of a third absent.

Four others had nothing whatever placed in their graves. Two of the remaining seven had broken pottery and a few arrow-heads with them. The others were buried nearly with their heads to the South. With the first were 62 bone beads and from their curved position plainly showed they had originally been on a string. The second had a neat little urn with handles, and containing a carved mussel shell, placed by his head. This pot was seven inches high, four inches in diameter, and was decorated with spiral lines. The third personage had nearly 300 glass beads between the ulna and radius. A small iron tomahawk near his hand showed furthermore that he had known the "long-knives."

The fourth Indian had a copper plate (Lake Superior copper) over his head, four and a half inches long, two inches wide; perforated near one end. Beneath his head were twenty-four broken quartz fragments about the size of an egg.

The fifth individual has a small copper earring, a tip to an arrow made of copper, and three large glass beads. The skulls of three of these five were taken out nearly whole. The average depth of the interment of these bodies did not exceed two and a half feet.

The owner of the land presented the writer with a copper plate and a stone tomahawk (greenstone) from the same spot. He claimed that after a heavy rain twelve circular spots about ten feet in diamather could be plainly seen in the field, that these spots had a reddish color, and were arranged in two rows. He further said that he thought them burnt spots of ground where the wigwams stood. That the field had been cultivated only a few years which accounted for the spot being still discernable. The bodies found by myself were *all under these spots*. *No skeletons* were exhumed in ground *not included* in these reddish circular places.

After the work here was completed, a mound on one of the high hills overlooking the valley was examined. Its dimensions were 35 x 45 feet diameter and six feet high. It was one mile north of Romney. The material was half stone, half earth. Seven men were all day in digging it through; the whole structure was removed. Nothing was found save one decayed skeleton. This skeleton had five large mica plates placed where his breast had once been, a copper bead has served as an earring, a slate ornament as a breastplate, and five black serrated arrow-heads as weapons. The mica was 7x10 inches in size. The ornament 5x2, with two perforations.

SCIENTIFIC NEWS.

—The Geological Society was organized at Ithaca, New York, on December 29, 1888. The original fellows number one hundred and nine. The admission fee is $10.

—The trustees of the Australian Museum, Sydney, have recently decided to continue the publication of the rich collection of drawings and MSS. left by the late Alexander Scott, and since acquired by them, and the work of revising and editing this material has been entrusted to his daughter, Mrs. E. Forde, and Mr. A. Sidney Olliff.

—The Marine Biological Laboratory has just issued its circulars for the coming summer's session. Dr. C. O. Whitman will be the director. He will be assisted in the Investigator's Department by Drs. Howard Ayers and E. G. Gardiner, and in the Student's Department by Drs. J. S. Kingsley and J. P. McMurrich and Prof. J. Ellis Humphrey.

The laboratory is located at Wood's Holl, Mass., near the laboratories of the United States Fish Commission. The building consists of two stories : the lower, for the use of students receiving instruction, the upper, exclusively for investigators. The laboratory has aquaria supplied with running sea-water, boats, collecting apparatus, and dredges; it will also be supplied with reagents, glassware, and a limited number of microtomes and microscopes. The library will be provided, not only with the ordinary text-books and works of reference, but also with the more important journals of zoology and botany, many of them in complete series. The Laboratory for Investigators will be open from June 3 to August 31. It will be fully equipped with aquaria, glassware, reagents, etc., but microscopes and microtomes will not be provided. In this department there are eight private rooms for the use of investigators not requiring instruction, who are invited to carry on their researches at the laboratory. Those who require supervision in their work, or, being already prepared to begin original work, desire special suggestions and criticism, or extended instruction in technique, will occupy tables in the general laboratory for investigators, and will pay for its privileges a fee of fifty dollars. The Laboratory for Students will be opened on Wednesday, July 10, for regular courses of seven weeks in Marine Zoology and Microscopical Technique. Botany will be taught for the present season during August. Opportunities will be given for collecting and preparing material for use in the class-room and for special lines of study. The fee for workers in this department is twenty-five dollars, payable in advance. The number of students will be limited to twenty-five, and preference will be given to teachers or others already qualified. By permission of the Director, students may begin their individual work as early as June 15, without extra charge, but the regular courses of instruction will not begin before July 10.

Applications should be addressed to Miss A. D. Phillips, *Secretary*, 23 Marlboro St., Boston, Mass.

—An important series of lectures on Evolution is being delivered in the Second Unitarian Church of Brooklyn (Dr. Chadwick's), under the auspices of the Brooklyn Ethical Association. The lectures are delivered on alternate Sunday evenings, beginning on Oct. 14 and ending May 26. They are issued in pamphlet form and may be obtained from Dr. Lewis G. James, President, No. 55 Liberty St., New York.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington.—Annual meeting, and election of officers for 1889, *January* 12, 1889.—The following officers were elected :

President—Lester F. Ward.

Vice-Presidents—C. V. Riley, R. Rathbun, C. H. Merriam, Frank Baker.

Recording Secretary—J. B. Smith.

Corresponding Secretary—F. A. Lucas.

Treasurer—F. H. Knowlton.

Members of Council—Geo. Vasey, J. H. Bean, R. E. C. Stearns, C. D. Walcott, F. W. True.

January 26.—The following communications were read : Dr. Cooper Curtice, Notes on the Sheep Tick, *Melophagus ovinus* Linn.; Dr. Geo. Vasey, New Species of North American *Gramineæ* of the Last Twelve Years ; Mr. Th. Holm, Contributions to the Morphology of the Genus *Carex ;* Dr. C. Hart Merriam, A New Species of Pika (*Lagomys*).

Natural Science Association of Staten Island.—*January* 12, 1889.—Mr. Wm. T. Davis read the following notes in regard to the appearance of shad along our shores :

" It has been the custom among those engaged in shad fishing in the bay to preserve a record of their first catch, which sometimes merely consists in chalking the date on the beams in the houses where they keep their nets and live, so as to lose no time at the turning of the tide. In one of these houses I copied the following dates, posted on the rafters overhead, as already described :

" April 3, 1873; March 30, 1874; March 28, 1878; March 30, 1879; April 4, 1880 ; April 5, 1881 ; April 4, 1883 ; April 9, 1884, 49 fish taken ; April 11, 1885, 1 fish taken ; April 11, 1886 ; April 9, 1887, 36 fish taken ; April 11, 1888, 29 fish taken.

" Mr. Wm. H. Wardell, who lives at Bay Ridge, Long Island, but who fishes from the Staten Island shore, has given me the following record of his first captures :

" April 3, 1878 ; March 29, 1879 ; March 28, 1880; April 9, 1881; April 5, 1882 ; April 5, 1883 ; April 1, 1884 ; April 3, 1885 ; April 5, 1886 ; April 7, 1887 ; April 11, 1888.

" One of the signs of the Indians' calendar was the blossoming of the 'shad bush' (*Amelanchier*), which occurs about the middle of April,

and it will be seen from the above dates to be an excellent guide, for it is not until its flowers appear that the fish come in numbers."

Mr. Chas. W. Leng presented the following memorandum: "In the Proceedings of April 14, 1888, a correction must be made in regard to the pupation of water beetles, the fact being that they pupate not under water, but in soil. Mr. Davis has this year raised the larvæ of *Hydrophilus triangularis* and supplied a part of the larvæ with soil under water and others simply with soil. The first lot refused to pupate, while many of the second lot formed pupæ in the ground."

THE INDIANA ACADEMY OF SCIENCE held its annual meeting in the Court-House at Indianapolis Dec. 25, 26, and 27. The following papers were read: Geographical Distribution of Umbellifers, J. M. Coulter; A Study of the Sub-epidermal Rusts of Grasses and Sedges, H. L. Bolley; The Future of Systematic Botany, J. M. Coulter; Raphides in Fruit of *Monstera deliciosa*, W. S. Windle; The Spines of Cactacæ, Walter H. Evans; Strengthening Cells and Resin Ducts in *Coniferæ* (by abstract), S. Coulter; The Epidermal Scales of Tillandsia, H. Seaton; Peculiarities of the Indiana Flora, J. M. Coulter; An Objection to the Contraction Hypothesis as Accounting for Mountains, F. B. Taylor; The Old Channel of Niagara River, J. T. Scovell; The "Collett Glacial River," J. L. Campbell; A Sketch of the Geology of Arkansas, J. C. Branner; Evidences of Shallow Water Deposition of Silurian Rocks, Chas W. Hargitt; Meanderings of the Arkansas River Below Little Rock, J. C. Branner; Occurrence of *Ancistrodon contortrix* in Dearborn County, Ind., C. W. Hargitt; Some Strange Cases of Color Variation in Animals, C. W. Hargitt; Amœba: a Query, S. Coulter; On a Striped Spermophile Mammal New to Indiana, A. W. Butler; Explorations of the United States Fish Commission in Virginia and North Carolina, D. S. Jordan; Analogy between River Faunæ and Island Faunæ, D. S. Jordan; Outline of Work in Physiological Psychology, W. J. Bryan; The Ancestry of the Blind Fishes, D. S. Jordan; A New Kind of Phosphorescent Organs in Porichthys, Fred. C. Test; Notes on Indiana Reptiles, A. W. Butler; On the Skull of the Larva of *Amphiuma means*, On the Hyobranchial Apparatus of *Amblystoma microstomum*, Further on the Habits of Some Amblystomas, O. P. Hay; Contributions to the Knowledge of the Genus *Branchipus*, O. P. and W. P. Hay; The Occurrence in Indiana of the Wood Ibis (*Tantalus loculator*), B W. Evermann; The Relation of Systematic Zoology to Museum Administration, D. S. Jordan; Observations on the Destruction of Birds by Storms on Lake Michigan, A. W. Butler; Additions to the Fish-Fauna of Vigo County, Indiana, B. W. Evermann; Some Notes on the Natural History of Guaymas, Mexico, O. P. Jenkins and B. W. Evermann. The Presidential address, "Religion and Continuity," was delivered Christmas night by Dr. D. P. D. John. The following officers were elected for the following year: President, John C. Branner; Vice-Presidents, T. C. Mendenhall, Oliver P. Hay, John L. Campbell; Secretary, Amos W. Butler; Treasurer, Oliver P. Jenkins. The Field-meeting will be held at Greensburg, Ind., in May.

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CONTENTS:

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THE MIMETIC ORIGIN AND DEVELOPMENT OF BIRD LANGUAGE.

BY SAMUEL N. RHOADS.

WHATELY, Archbishop of Dublin, remarked a half-century since,—"man is not the only animal that can make use of language to express what is passing in his mind and can understand, more or less, what is so expressed by another;" a remark which echoes with the increasing emphasis of another fifty years, the pious poet's couplet—

> "I shall not ask Jean Jacques Rousseau
> Whether birds confabulate or no."

Darwin thinks "the sounds uttered by birds offer in several respects the nearest analogy to language: for all the members of the same species utter the same instinctive cries expressive of their emotions, and all the kinds that have the power of singing, exert this power instinctively, but the actual song is learned from their parents or foster-parents."

The longer this subject is critically considered, the more are we convinced that the communication of ideas by means of sound and gesture (language) is instinctive and common to all animals;—that it is a genetically transmitted faculty, quite independent, in its earliest manifestations, of experiential or empiric knowledge, and that laws, governing the development of

any one language, have an equal application to all the rest. It is quite generally conceded that the present status of human language is the result of slow developement or evolution from the innate, inarticulate and exclamatory utterances of our human progenitors.

We see apt illustration of this in the gesticulations and cries of the newly born of man, bird or beast; which cries, originating in the primal idea of want, are its natural, spontaneous expression, and, in consonance with the other faculties, develop through early life to maturity, furnishing, in the momentary individual life, a brief, actual epitome of the genesis of language through successive generations in the infinite past. Therefore in so far as he may have "no knowledge but a cry" man may account himself not only a little lower than the angels, but quite as low as the creatures over whom he has dominion. Thus far language is an instinct common to all, and, in nature, identical among all animals; a conclusion necessitating in us the sort of humility which nowadays leavens all progressive inquiry.

Of language, in its original and primitive exercise, such a view is tenable, but in its wider acceptation, as Horne Tooke remarks,—"language is an art, the developement of which is consonant with that of the mental faculties," and it is reasonable to infer that while articulate language (speech) is peculiar to man, distinctly separating him, as Cuvier states, from other animals, "it is not the mere power of articulation that distinguishes man from the other animals, for as every one knows, parrots can talk, but it is his larger power of connecting definite sounds with definite ideas." [1]

It follows therefore, that the language of birds differs not in kind from that of man, though far removed therefrom in degree of perfection as an art. Allowing for the difference in mental capacity, betwixt man and the lower animals, the comparative attainments among men in the linguistic art exhibit disparities no greater than may daily be observed of birds *inter se*. As the singing of a thrush to the chatter of sparrows, so the solo

[1] Descent of Man. Vol. I., P. 53.

of a Patti to the hurly-burly of an Italian marketplace; or (extending parallels to tribal characters) if we compare the Fuegian or Caffiric tongues with those of more enlightened races, the contrast, however startling, finds its equivalent in a comparison between oscine and non-oscine orders of birds.

Between the higher and lower oscines there exists the same gradation of vocal attainments as exhibited by the dialects of nations speaking a language derived from the same parent tongue, and Bechstein, pushing the analogy further, instances how slight geographic differences of song among members of the same species inhabiting widely separated districts, may be appositely compared to "provincial dialects" among speaking peoples.

The inference of Darwin, "that an instinctive tendency to acquire an art is not a peculiarity confined to man" receives daily confirmation in the life history of all the creatures. It is apparent not only in the language of birds, but also in the construction of their nests and in their methods of discovering and storing food.

The ratiocinative processes which distinguish artificial from natural or innate actions are unmistakably apparent in the musical performances of our higher oscine birds.

Among the North American Turdidæ are several species which habitually retire to more secluded portions of their forest haunt to rehearse, in critical undertone, difficult bars and passages of the favorite song, and it is demonstrably true that the older and more experienced of these vocalists surpass the younger by reason of their longer practice.

In this respect bird-language has developed into a fine art analogous to the attainment made in bird-architecture, as exampled by the play-houses of the Bower Bird and two American wrens,[1] and in the ornate embellishment of their nests by the Trochilidæ and Vireonidæ.

Barrington, in his paper on the "Songs of Birds"[2] has well remarked that "that there is no better method of investigating

[1] *Troglodytes aedon & Cistothorus palustris.*
[2] Trans. Phil. Soc. 1776.

the human faculties than by a comparison with those of (other) animals," and *vice versa* the same will hold in an inquiry like the one now before us. In the evolution of language as in everything else, we may recognize the all-pervading unity of plan and purpose, the "one law, one element and one far-off divine event to which," not man alone, but "the whole creation moves." This granted, the wealth of all past philological research is at our disposal and by so much are we warned of quicksand hypotheses and set upon a theory of some endurance.

Perhaps the theory most generally accepted as accounting for the origin of human language, is the onomatopoetic or mimetic, coupled with that elaborated by Wedgewood,—the interjectional or exclamatory theory. Wedgewood's theory has more to do with the original and instinctive sounds which form the primitive utterances of the speaking animal, while the mimetic accounts for the subsequent development of language into an art. Leaving all discussion of the tenability of these in their application to human language, let us apply them to birds.

The most cursory study of the songs of our feathered favorites must lead every inquirer to believe them the result of imitation, and a more critical examination would demonstrate that not only does this apply to the transmission of song from one generation to another, but it may be held to account for the origin and development of all bird-language in the past.

Consonant with our proposition, we find among the least specialized of avian forms that language is limited to half audible hissing or choking sounds or even to life-long silence,—an attempt merely, with sure-attendant failure. In such, language has been doomed to perpetual infancy; development in this direction has done nothing, has nought to do with it; it is not this noise or that noise, but *a* noise they are trying to make. The primal death-birth of speech is the result. Except as a proof that language, out of the chaos of silence, had a beginning so dumbly weak and abortive, we here have nothing to do with it either. Next come such as have found a tongue; an

unruly, screaming or croaking member, 'tis true, yet a tangible something for us to hear and heed; its products tangible too, for there is some attempt at combination and modulation there for discriminating ears. And so, from Pygopodes ascending, we start with promises, attempt and failure to climb the vocal scale through Longipennes upward. I will classify a few of the better known species illustrating the mimetic development of bird language into three,—1. Mimics of sounds in animate nature exclusive of other bird-notes: 2. Mimics of sounds in inanimate nature: 3. Mimics of song and human language. In the first class are many, probably a majority, whose notes in greater or less degree are intentionally imitative of those of other birds, and, for sake of illustration, are not so significant as those which (unlike the Mocking-bird, Catbird and Carolina Wren etc.) are not intentional, but seemingly unconscious mimics of animate sounds produced in their immediate environment. The Mocking-bird, Catbird, Shrike and Jay are studied and artistic imitators of their feathered associates, indicating the perfection to which bird-language has developed as an art, but if we would seek examples of the primary, instinctive exercise of the mimetic faculty, the notes of the Prairie, Bluewing, and Yellow warbler, the Grasshopper warbler of Europe, the Yellow-wing and Savannah sparrow together with most of those of the Ardeidæ, Anatidæ, Rallidæ and of some of the better known Strigidæ and Falconidæ, afford a better illustration. The resemblance of the notes of many smaller birds to those of insects of contemporary habitat is very noticeable in the songs of the five first mentioned in the above list.

Blue-winged Y[illegible]

Each of these sings so like a grasshopper haunting its respective locality as to deceive the unpracticed ear, causing the careless observer to overlook them entirely.

Among the lower orders, this ornithic mimicry, owing to the less complicated and exclamatory nature of their language, is more easily studied. To receive forcible proof of this, let the reader adventure on an April evening's tramp along our river marshes. To most, the novelty of such an experience would lend just the necessary stimulus to imagination and when, after

having every sense of musical concord outraged by the vast callithumpian chorus, there should come, as there surely will, an echo of tenfold emphasis from overhead, eliciting now here, now there, the wierd password till all is hushed along the shore, —then, methinks, in sounds not sweet he could detect a direful harmony.

But the Qua bird's is as one among the many voices of the night which nearly concerns us. Of perhaps four species of frog which in the spring make such localities nightly jubilant, two, more especially, are as well "taken off," vocally speaking, by the Bittern and Green heron as they are in the more literal sense of the phrase. To the third it seems fair to assign the origin of all quacking and its corresponding modifications among the Anatidæ, while the fourth makes a sound so like the notes of a Sora Rail as to put one in doubt which is the best mimic. Turning over the pages of Nuttall's "Ornithology" at this moment, the following, relating to the morning cries of the yellow-breasted Rail seems opportune. "As soon as awake, they call out in an abrupt and cackling cry, 'kreck, 'krek, 'krek, 'krek, 'kuk 'k'kh, which note, apparently from the young was answered by the parent in a lower, soothing tone. The whole of these uncouth and gutteral notes have no bad resemblance to the croaking of the tree-frog, as to sound."

To the student of shadows of things gone by, nocturnal sounds and scenes are a fitting environment. How to-day's dark guess gathers increasing light by this backward look into the infinite night of myriad yesterdays, where lie, in silent readiness, the unspoken but not unspeakable secrets of the past!

In considering the second class of bird-mimics,—viz., those which imitate sounds in inanimate nature, we approach nearer the question of the origin as distinguished from that of the development of their language. Aristotle goes to the root of the matter when he queries regarding the European Bittern's note, —"why do those which are called Bomugi, and which are fabulously reported to be bulls consecrated to some deity, usually dwell among marshes which are situate near rivers? Is

not such a sound produced when rivers inundate marshes or marshes overflow their boundaries and are either roughly checked in their impetuous course by the sea and thence send forth a rushing sound? Similar sounds are produced in caverns underground into which currents of water rush and dispel the air through small apertures."[1] According to both the Mosiac and Darwinian genesis we are to believe that this elemental turmoil and river rushing was a primal thing and precedent of reptilian life just as reptilian life preceded avian life; therefore the whole family "Bomugi" may have had their music second-hand, through batrachian ante-cessors, from wind and wave and chafed shore. If this be true of Bomugus, it is true of all, however shrouded now by the intricate processes of their evolution from such crude, unmusical beginnings to the higher minstrelsy of the present.

At risk of the imputation of having a too fertile imagination, I will separate the second class of sound mimics into two divisions,—viz: 1. Mimics of water sounds; 2. Mimics of wind sounds. The long and short-billed Marsh Wrens and the Winter Wren sing songs so in harmony with their aquatic surroundings that you must be attentive to separate them from the rippling, bubbling sounds of moving water which they affect, the songs of the former being as characteristic of a marsh-receding tide as the other is in its unison with the prattle of woodland rivulets. The same may be observed of the Dipper, Kingfisher, Aquatic Thrush, Blue-yellow-back Warbler, Seaside Finch, Swamp Sparrow and others of like predilections. Many years ago, when the subject began to claim my attention, I call to mind having nearly decided that the Swallows all sang improvisations of a single theme, the rapid clattering of their own mandibles. But on a later occasion, it having struck my fancy that I detected in the joyous little flight-song of a White-bellied Swallow coursing near by, a likeness to the dripping sound of water, I waited till its repetition and then asked my companion, a wide awake negro boy, if he heard "that bird"? "Why," said he, "was that a bird? I thought it was

[1] Aristotle, Problem II., 35.

rainin'." A showery April day had sufficed to complete the illusion.

For a long while, too, the shrieks and hootings of sundry owls continually suggested an unnameable likeness to other sounds in nature, but save that impossible original in the north window casements, none other presented itself to mind.

Then in hypothetic despair I bethought me of an empty porter bottle which once hoo-hooed and shrieked, to the wind responsive, from a nigh fence panel, till a wrathful storm made end of it.

With twofold thanks that the bottle was empty, I now am wont to picture how, ages ago, the mute, inarticulate Scops sat taking music lessons in his porter-bottle house, and how in piny solitudes remote, great Bubo tuned those bass-viol monotones of his in full accord.

The mourning Dove is typical of a family whose voices are in symphonious keeping, with the sighing cedars and moaning pines of their choice. The same correspondence is noticeable in species which, like the Grouse, Vulture, Swan and other aquatic kinds are mute or nearly silent.

In contrast with the silent Vulture, content with silent victims, the nearly related Eagles and Hawks are a screaming, noisy set of birds which seem to have adopted for their own a quintessence of the dying utterances of their victims merely because of carnal policy and from no delight in language in itself considered.

However, the further consideration of this, more properly belongs to the last division of mimics, *i.e.* those which intentionally imitate the sounds produced by their contemporaries.

It were best, ere passing on, to allude to a few others of those birds whose notes resemble the sounds produced by the action of wind. The Broad-wing Hawk's love-notes are like the sound of high-whistling winds or the shrill creaking of interfering tree limbs, or may be imagined by another to be the exaggerated shrieking of a stricken hare or field-mouse. Possibly, yes, probably, all of these may have had combined influence.

The same previously noted of Doves, may apply to the "pewee" of the Flycatcher, the "yank yank" of Nuthatches, the scolding of our Vireos, parts of the song of many higher oscines, (Turdidæ and Icteridæ), and all songs of the more essentially whistling birds, or at least, such part of it as they have not acquired from the whistling Batrachia. Whistling, and its fife-like modulations was likely among the smaller thick-billed families, to be the natural outcome of the imitative faculty, limited in quality and variety by the peculiar structure of their mandibles, but the appearance of tenuiostral forms enabled the more specialized vocalists to produce those more flexible, flute-like songs, which characterize them.

The third class division of mimics will include birds unmistakably imitators of their contemporaries in song,—mockers in the strict sense, and indebted to furred and feathered originals for the greater part. All in this class have a score of their own, a thread of original prose melody, lavishly embellished by poetic quotations from their favorite authors. By way of distinguishing these from the rest let us compare the Mockingbird and Song-Sparrow. Each are songsters *par excellence* in their separate classes; each boast of a varied repertory, yet in the last, these variations are merely varietal combinations of the "sui, sibi, se or sésé" solus of ancestral Melospiza, and (*inter se*) differ only by numerical sequence of the syllables in a "four foot iambic," or by a change of accent or the addition of a final syllable, convert iambus to trochee and wind up with anapest flourish; whereas Mimus, multiplying his own wild originality by a hundred borrowed roots endlessly declines and conjugates, or with Pentecostal inspiration speaks all languages in one. From "yon trim Shakspeare on the tree," we pass again by exquisite minor gradations of the feathered genius, to sweet sparrow-rhymes and rhymesters many. Past Brown Thrush, Cat-Bird and White-eyed Vireo, by whom a sort of five minute rule has been set up in which each borrowed phrase is given impartial hearing, according to calendar, as if it were;—so on, by way of the Baltimore Oriole, Carolina Wren and others, which are not chronically mockers, but hold that talent

in heroic reserve for after-dinner speeches, we reach the notes of such as quickened the highly sensitive ear of a Nuttall or Burroughs by some vague likeness in them to other note of bird or beast,—chance utterances remotely suggestive of a first attempt at exercising the latent talent for mimicry.

But so nearly do these nice discrimations bring us to the mysterious borderland where fact and fiction intermingle, it were well to pause and confess our fallibility.

In his "Birds in the Bush," Mr. Torrey aptly remarks of a turn or grace-note, in the song of *Dendroeca virens*, which he was tempted to number among "the latest" of philological discoveries, that "perhaps after the lapse of ten-thousand years, more or less, the whole tribe of Black throated Greens will have adopted it, and then when some ornithologist chances to fall in with an old-fashioned specimen who still clings to the plain song as we commonly hear it, he will fancy that to be the very latest modern improvement and proceed forwith to enlighten the scientific world with a description of the novelty."

Beyond what has been said of this native genius in feathers, I may not in present limits so enlarge as to notice that interesting subject, the influence of domestication and human training upon the language of birds, save to note that every experiment made with a view to solve the problem of its origin and development justifies the belief that bird language, as now existent, is, like human language, "the result of some operation of the imitative principle, quickened in all probability by circumstances which we are able to a certain extent to reconstruct, and aided at first very largely, but always in lessening measure, by the language of sign and gesture. [1]

The joke of Prof. Schleicher, "If a pig were ever to say to me, 'I am a pig,' it would, *ipso facto*, cease to be a pig," while controverting the ultra Darwinian theory by its reference to the impassable language barrier, twixt man and the rest of the animal kingdom, nevertheless assumes a serious and questionable significance if the names of certain birds were substituted for the pigs.' Independently of the question of man's descent,

[1] See Philology; Appleton's Ency., New Ed.

however, the result of Darwin's life-long study of psychical and physical evolution receives wonderful confirmation in the family resemblance of notes peculiar to species whose genealogies, according to the development hypothesis, are tracable to the same ancestry. The Icteridæ form a group, the genera of which emphatically demonstrates this.

In the song of the Bobolink, a well known representative, he who runs may read a sure word of prophecy, proclaiming to the ear in its every emphasis, the same scientific facts as does his anatomy to the eye.

Who, that hears him say, in lusty May-song, "I'm a finch, I'm a finch, Icterus, Icterus, Quiscalus, Molothrus, Sturnella, one and-all; as you'll see if you look at me, chee! Agelæus et cetera, all linked in me, a bobolink, bobolink, as you can see!"—dare contradict a word of it on biological grounds?

Not less confirmatory of this and of the theory of the mimitic origin of bird notes is the evidence given by species of widely separted generic characters which frequent the same sort of habitat and are subject during life to the same environing influences.

Some of these, as the Robin, Scarlet Tanager, Rose-breast Grosbeak and Baltimore Oriole, have song-notes in common, while the Woodcock, Night-Hawk and Snipe, have nearly the same squeaking call-note when associated together at night as frequently happens, thus indicating that their inspiration was derived from like natural sources, and that, in harmony with their limited vocal needs, it has remained content with squeaking. But, strange to relate, the members of this same trio have each made an attempt at something higher, and, (which is stranger than all) with nearly identical results. In the Goatsucker it is a hollow, booming sound, produced by its sudden downward descent during flight; in the Snipe and Woodcock it results from a whirring of wings during a slowly ascending and descending spiral flight. Such is the commonly accepted belief of observers of these manœuvres, and, if correct, they illustrate how, in the retarded organic development of any faculty, nature supplements it by mechanical ingenuity.

May we not in conclusion, fittingly adopt the words of a modern seer, with him agreeing that "between two opposing tendencies, one urging to variation, the other to permanence, (for nature herself is half radical, half conservative) the language of birds has grown from rude beginnings to its present beautiful diversity, and whoever lives a century of milleniums hence, will listen to music such as we in this day can only dream of. Inappreciably but ceaselessly the work goes on. Here and there is born a master singer, a feathered genius, and every generation makes it own addition to the glorious inheritance!"

A MONTH IN THE EASTERN PHILLIPINES.

BY J. B. STEERE.

WE spent the last days of March, 1888, at Cebu, in packing our collections from the Central islands. We were fortunate in finding an American vessel in port, sailing to Boston, and nearly loaded with sugar and manila hemp, and shipped home several cases of bird skins and other valuable and perishable collections by her, while the bulkier part, corals and sea shells, were left to be forwarded in the same way at a later date. We then took passage on the little Spanish steamer "Gravina," for Catbalogan on the island of Samar, the most eastern of the archipelago. The weather was of the ordinary Philippine kind, calm and with smooth seas. We left Cebu about noon, passed by the northern end of Bojol, and were then in sight of the mountains of Leite, and we spent the evening in coasting up the west shore of that island. The next morning when we waked up we were lying at anchor in front of the town of Catbalogan. We were started out of our berths a little sooner than common by an outcry among the Spanish passengers, and a call for the "Naturalistas Americanos." Hurrying into one of the passage ways, I found a Spanish military officer

standing in a tragic attitude, with his sword thrust through a poor little centipede, which he had pinned to the floor.

The harbor of Catbalogan is formed by several small islands but is not considered safe in storms from the northwest. The town is on low ground near the sea, and has about ten thousand inhabitants, and shows the usual church and parish house with a governor'sand other officer's residences, for it is the capital of a province; in addition to the usual streets of Indian houses supported on posts in the ordinary way. The town had an unmistakable appearance of age and unthrift, though the little square in front of the church was decorated with triumphal arches and flowers, for we had brought a new governor with us, the same who had so courageously attacked the centipede in the morning.

The island of Samar is some one hundred and twenty miles long, by thirty or forty broad, and is said to have two hundred thousand inhabitants. Its native name is *Ibabao*, which means *up above*, and we were certain before we had left it that it was well named. It is very mountainous and steep so that a great part of it is uncultivable. The exports are chiefly of manila hemp which is sent to Cebu or Manila for shipment.

The captain of the steamer landed us and our goods on the beach and steamed away, and we were left again to find a home among strangers. There was no hotel, as is usual in such towns, and the people were too busy with the new governor to care for us, and it looked for some time as if we might go hungry and without shelter unless we took refuge in the *tribunal*, the court-house, jail and common assembly room of the Indian population, but after noon we found an empty house and making a bargain with the owner, and hiring a young Indian for cook, we moved in that night. Our house was out on the borders of the town near the hills. It had a room large enough to hold our hammocks, and another back one open on all sides, serving for a kitchen, dining-room and a place in which to skin birds. The hills covered with second growth were just behind us and we could see unmistakable patches of virgin forest on the mountain sides, two or three miles far-

ther back and we concluded to make the place our headquarters for the month we had devoted to this part of the island. The next morning I dressed and started to the governor's residence, to present our passports and other papers, but the rest of the party, anxious to see what could be found in this new field, were in the hills before my arrival, and the reports of their heavy guns were rolling down upon the town as if it was besieged. A squad of Indian soldiers were hurried out after them, and made out to capture one of the party, and march him in, just after I had shown our papers, when he was released without ceremony.

The birds, in the jungle of second growth near town, were, many of them, the same we had found in other parts of the group, but the first day's hunt proved that we had reached a new and distinct location.

A number of birds, including the large Philippine crow, the yellow oriole, the black, and bald headed starlings, the white collared kingfisher, one or two sun birds, the fruit-thrushes, and the little scarlet breasted parrots, and many others, are such common residents about the Indian towns, and especially in the coco groves, and are so rarely found in the virgin forest, that we learned to expect them everywhere we went. Their distribution may have depended in part upon the habit the natives have of capturing these birds and carrying them from place to place. Since the islands have been inhabited there can be no doubt that man has been the chief agent of distribution, and of much greater importance than storms, floating timber, etc., all taken together.

We had,at a step, passed from the region where the dry season was at its height in Negros, Cebu, and Bojol, to where the rainy season was beginning. The mountains behind were much of the time enveloped in dark mists and thunder clouds and one or two showers had already reached down to the town. The steep hills between us and the true forest were wet and slippery, and we found our best means of reaching the hunting grounds was to employ native boatmen to pilot us up the little tidal river in their canoes to the foot of the mountains. The

authorities seem to have become discouraged in trying to make roads in such a country, and though a bridge had been built over the river, the road after running along the beach for two miles, had been abandoned, and all the commerce of the place is carried in boats and on men's backs. The mountains were heavily timbered and very steep. Several mountain streams formed the river, these flowing along narrow ravines, running for some distance over flat-ledges of rock and then breaking over perpendicular precipices in waterfalls into deep pools below. We found the beds of these shallow streams our best paths, and adopting the native *alpargate*, a canvas sandal with hemp sole, we spent our time in following their beds, shooting from the overhanging trees, and the mountain sides above. It was still dry at the town, though it rained nearly every day in the mountains, but usually in the afternoon, and everything was dripping with moisture. We seemed to be in the rain clouds themselves. The land leeches were swarming and very troublesome, even making their way through the meshes of our stockings. But with all our discouragements we were rapidly adding species new to our collection, and new to science. Among these were a new squirrel, a new broad-bill of the genus *Sarcophanops*, first described from Basilian, two new woodpeckers, and another fruit-thrush, and a little crow, these two latter staying in the mountains and not interfering with their relatives about the town below. A great horn-bill proved to be distinct from its allies in Mindanao and Luzon.

A division of the party took a native boat, and pushed down to the south into the strait of San Juanico, between Samar and Leite, and stopped for ten days at the village of Babatgnon, on the latter island. The fauna appeared to be identical with that from Samar as might be expected, the strait being in many places not over a mile or two in width and this frequently narrowed by small islands.

Toward the latter part of our stay, the rains came farther and farther down the mountain side, and storms became frequent at the town itself, and so continuous in the mountains as to hinder us considerably in our work. Reptiles were abund-

ant, crocodiles were found in the river we used as a highway, and our Indian boatmen would devoutly cross themselves and say their prayers before wading into the deeper places. Nearly every day we started the large plant-eating lizard, called *ibit*, from the bushes on the sides of the river, and they frequently made directly across the stream in front of us, not swimming in the water, but moving rapidly over the surface, apparently chiefly by strokes of the broad flattened tail and of the hind feet, the head and fore part of the body being elevated high in the air. This is much nearer the position of birds in swimming than that of most reptiles. Perhaps some of the fossil reptilia moved in this way. We encountered two or three cobra de capellos in our hunting. One of them, an immense fellow, lay coiled behind a big rock with its head raised and neck flattened in the traditional style. The *Naturalista Americano*, was within fair biting distance of him as he turned the corner of the rock, and was so frightened that he allowed the snake to drop down and glide out of sight. He did not do much collecting the rest of that day, but spent most of his time in looking out for snakes. There is no doubt but that the cobra, hearing the noise, was looking out for food, but finding the game too big to swallow, got out of the way without striking. One of the under officers at Catbalogan had a large python which he had kept for a number of years in a cage. The snake was about fifteen feet long, and as thick as a man's thigh. He was fed once a month, and his appetite demanded a good sized dog at a meal. As the time for his dinner arrived, he became active, gliding about the cage with head raised and when the trap door was lifted and the dog dropped in it was seized before it touched the bottom, and a coil being thrown about it, it was crushed to death before it had time to howl. After his meal the snake lay for weeks in so deep a sleep that I could not waken him by punching him with my cane. One could run over such a snake in the jungle and hardly know it. A large number of deaths undoubtedly occur in the Philippines from poisonous serpents and pythons, but from the apathy of the people but little attention is paid to it. If a person is killed in this way it is his *suerte* or fortune, just

as it is of the gains or loses on a cock fight. Remedies for snake poison abound as in other countries. One old Indian who had been to Manila and had dabbled in drugs, assured us that if he could reach the person bitten before he was quite dead he could save him by applying muriatic acid. The flying lizard, *Draco*, found here differed from those we had collected in other parts, in its larger size, and in having the under surface of the membranes bright red in color.

At the end of the month devoted to Samar and Leite, we found a little brig, built in the Philippines, and commanded by a Spaniard, loaded with manila hemp and bound for Manila. Making a bargain with the captain to land us on the island of Masbate, which lay very close to his route, we hurriedly gathered our collections and luggage together, and embarked.

ON THE DEVELOPMENT OF CALIFORNIA FOOD FISHES.

C. H. EIGENMANN.

FROM a biological standpoint the Surf Perches are the most interesting of the California fishes. The species inhabiting the shores of California are probably all well known, and the later stages of their larval development have been well treated by Agassiz, Blake and Ryder. Dr. Charles Girard was able to examine younger stages than the other writers, but he did not contribute much to our knowledge of them. Until now the ripe eggs and embryos of these fishes have not been seen. During the past two months, December and January, I have been enabled to examine many individuals of almost all the species found in San Diego Bay. In most of them I have found embryos or ripe eggs. *Micrometrus aggregatus*, on account of its abundance, the ease with which it can be caught, and the fact that different individuals of the same date have young in widely different stages of development, has proved to be the

most interesting of the species. An account of it will serve for all the others. As is well known, the egg-bearing lamellæ are broad sheets which are suspended from the roof of the ovary; there are usually three of these sheets in each half of the ovary. The eggs are very small (.2 mm.) as compared with the eggs of other fishes: they protrude from the lamellæ much as other fish ova do and they seem to be surrounded by a more transparent area. I have seen the eggs of several species but for lack of proper facilities to study the material collected a more detailed description cannot be given at present. The eggs of *Micrometrus aggregatus* have the yolk collected in spherical masses, and there seems to be no oil globule, while the eggs of *Ditrema jacksoni* have from one to three oil globules. Whether the eggs are fertilized before they are freed from the lamellæ, I cannot state at present; long before hatching, the eggs are found lying in the folds of the ovary. The eye is much less conspicuous than in other fish embryos, and the hypertrophied hind gut is developed before hatching. In larvæ in which the mouth was apparently not yet formed, the vent was open and the vigorous peristaltic action which was confined to the hind gut began at the vent and traveled forward; this would seem to make it probable that food is taken in through the vent in the earliest stages of the larval existence. A structure whose significance has not yet been determined is found in larvæ less than half an inch long. It consists of a spirally twisted, opaque white substance lying free in the hind gut; it terminates posteriorly in a knob; its anterior connection has not been traced. During the peristaltic movement mentioned, this spiral moves freely, and in several instances it was entirely withdrawn from the hind gut, the knob at its posterior extremity seeming to form a partial plug at the anterior end of the posterior intestine.

The first indications of the peculiar prolongations of the vertical fins was noticed in larvæ an inch long; all the fins were well developed and the interradial membranes projected as short, broad flaps beyond the tips of the rays.

The Herring, *Clupea mirabilis*, enters the bay of San Diego

in great numbers during December and January. The eggs are very adhesive when first deposited, but half an hour after deposition they lose their stickiness and remain free when loosened. The yolk is collected in spherical masses. The protoplasm is yellow, and the formation of the germinal disk can readily be watched. Strands of the protoplasm can be seen extending from it into the yolk. The first cleavage furrow is formed about two hours after fertilization, and the first cleavage occupies about forty-five minutes. The furrow travels slowly towards the base of the germinal disk, which it reaches in about twenty-eight minutes; at this stage the two newly formed cells seem well separated. As soon as the furrow has reached the base of the disk it begins to retreat, leaving but a line to separate the two cells. When the furrow has entirely retreated, the division of the two cells is not very plain, and the second furrow is immediately formed. The division of the disk into four cells is more rapid than its division into two. The further development very much resembles that of the shad as it is described by Ryder; it is, however, much slower. The blastopore closes about thirty hours after segmentation. The heart is formed near the close of the second day. Kupfer's vesicle appears about fifty hours after fertilization. On the sixth day one shell was found, but the escaped fish could not be seen. Other embroyos continued to be active in the shell five days longer, when they died.

The Smelt of California, *Atherinopsis californiensis*, is one of the most abundant of the food fishes. It enters San Diego bay in December to spawn. The eggs are large and transparent, and, during the earlier stages of development the oil is distributed in a number of globules, while in a later stage but a single oil globule is present. Each egg is provided with about ten long filaments which differ somewhat from those of Fundulus. The base of each filament is enlarged, disk-shaped and apparently hollow, and the substance of the zona seems to enter it. The filaments are uniformly distributed over the surface of the egg, and in the ovary they are coiled around the egg in one direction only.

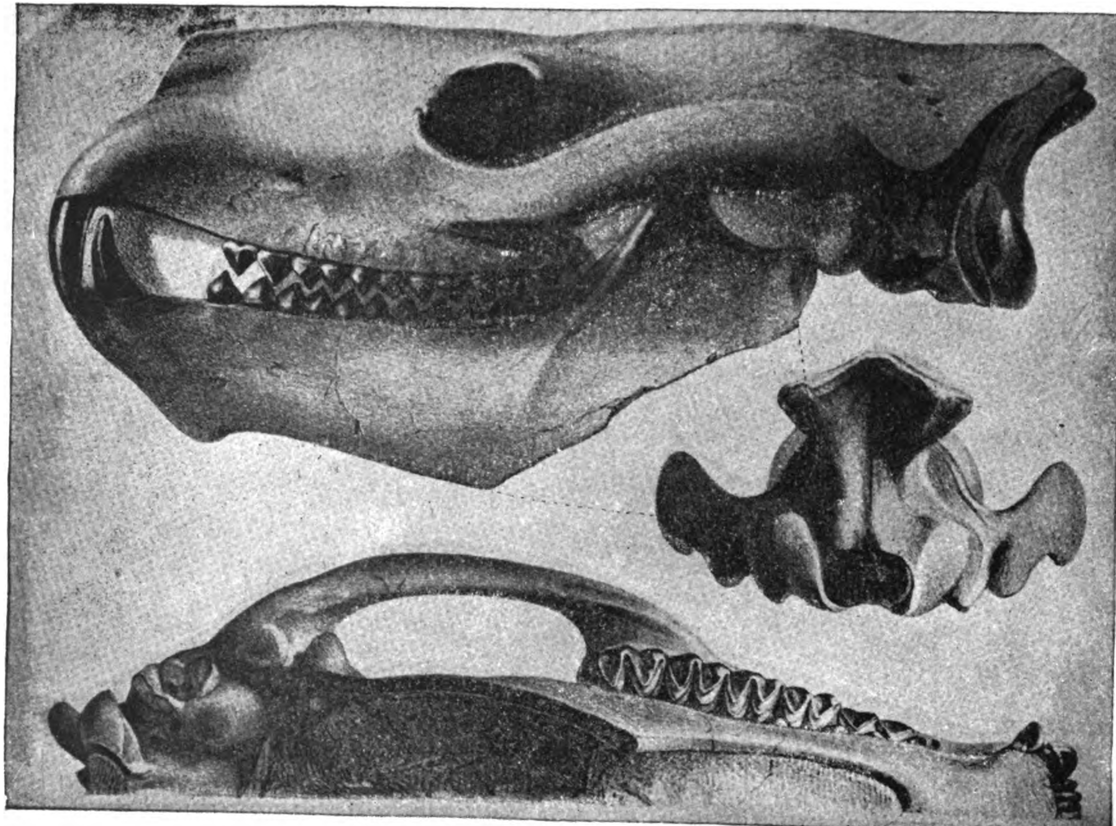
The eggs were artificially fertilized; after three hours twenty-five minutes, the first cleavage was completed. Twenty minutes afterwards four cells had been formed. The time of the development of the other phases may be best tabulated:

16 cells	4 h. 45 min.	after fertilization.
32 cells	5 h. 10 min.	" "
First horizontal furrow	6 h.	" "
Beginning of blastula stage	28 h.	" "

At this stage the free nuclei are very abundant and cover about half the yolk. They are much larger and more numerous just at the edge of the blastula. The blastula stage lasts less than half an hour; the embryonic shield is first seen forty-one hours after fertilization. Two and a half days after fertilization the optic vesicles appear. The blastopore closes after about eighty hours. Kupfer's vesicle and the myotomes appear on the fourth day, the heart on the seventh day; on the twelfth the embryos move vigorously; on the sixteeth day pigment spots appear on the top of the head and along the median line of the back. The water space which at first was inconsiderable has greatly increased. The embroyos were at this time near hatching, but, unfortunately died.

Some larvæ of this species procured afterwards show the following pigment spots: A series along the median line of the back from the occiput to the caudal fold; a spot above the posterior portion of each eye; one medially above the front of the eye; a small one at the nares. A series of spots along the median line of the sides; numerous spots over the air-bladder and upon the abdomen. Later a series is formed along the base of the anal fold. Yellowish dots are found between the black pigment spots of the back and sides. These larvæ have a continuous fin fold from the abdominal region of the back around the tail to the vent; a smaller fold in front of the vent. The embryonic rays are most numerous and best developed at the tail. The caudal shows heterocercal tendencies.

PLATE III.



Agriochoerus guyotianus Cope.

THE ARTIODACTYLA.

BY E. D. COPE.

(Continued from page 1095, Vol. XXII., 1888.)

IN passing from the lower to the higher Artiodactyla we encounter a succession of modifications of the skeleton which give the suborder a higher specialization than any other among mammals. These may be considered under three heads: First, the consolidation of the bones of the carpus and tarsus; second, the development of a tongue and groove of the humero-cubital and metapodio-phalangeal articulations; and third, increased complexity of the intervertebral articulations.

Of consolidation of the bones of the feet we have first, the coössification of the larger two elements of the distal row of the carpus and tarsus; viz.; the trapezoides and magnum in the former, and the meso- and ectocuneiform in the latter. This commences in the Oreodontidæ (Scott) and continues throughout the succeeding families. The next modification of this kind is the coössification of the cuboid bone with the navicular. This commences with the Tragulidæ, and continues throughout the remaining families. The fusion of the metapodials into cannon bones first appears in geological time in the Tragulidae, as does also the fusion of the ulna and radius (in Hypertragulus), and also in the contemporary Poëbrotheriidæ. The reduction in the number of the digits progresses with varying correlation with the other changes, from five in Oreodon to two in Camelus and Bos. As already explained, similar reductions took place in the Eocene members of the suborder, Anoplotherium having the digits 3-3, and Xiphodon 2-2.

The mechanical cause of these coössifications must be regarded as strains incurred in the act of rapid locomotion. Where not sufficient to produce actual flexure, strain is met by resistance and increased nutrition of the tissue, resulting in a strengthening of material at the point of resistance. With such coössifications comes increased mechanical effective-

ness. Kowalevsky has shown that with the reduction of the number of the digits, the metapodials of those which remain, have increased in transverse diameter, so as to articulate with two distal elements of the carpus and tarsus each,

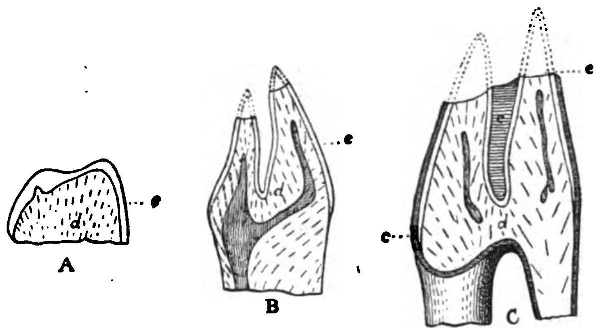


Fig. 7. Transverse sections of molars of Artiodactyla, showing successive complications of structure. A. *Sus erymanthius ;* B. *Ovis amaltheus ;* C. *Bos taurus ;* from Gaudry, Enchainements. Letters: *c*, cementum ; *e*, enamel ; *d*, dentine.

instead of with but one, as in the primitive types, as Anoplotherium, Hyopotamus and Hippopotamus. (Fig. 8.) He shows that where this expansion of the metapodials did not

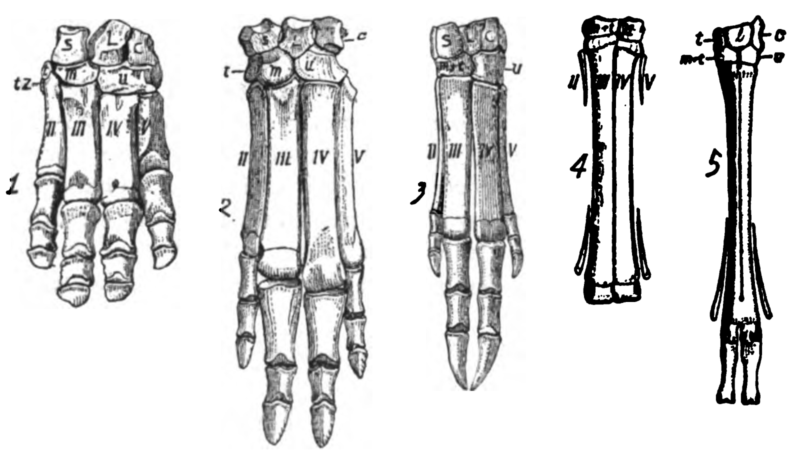
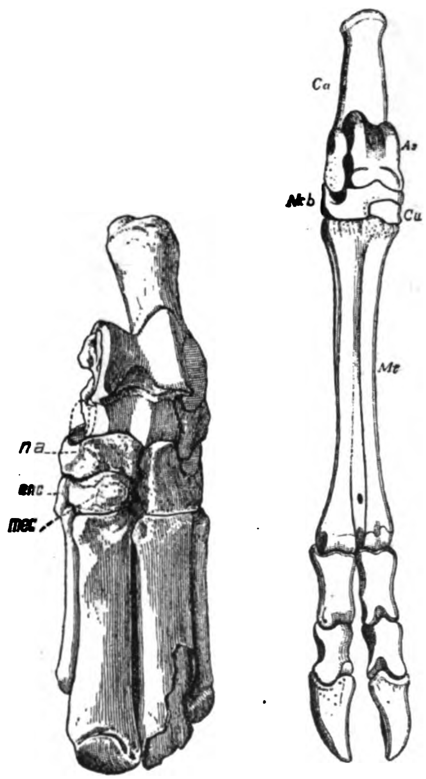


Fig. 8. Fore feet of: 1. Hippopotamus; 2. Hyopotamus ; 3. Dorcatherium ; 4. Gelocus ; 5. Cervus. From Kowalevsky. *S*, scaphoid; *l*, lunar ; *c*, cuneiform; *tz*, traperium ; *t*, trapezoides ; *m*, magnum ; *u*, unciform.

take place, the type became extinct, as in Elotherium. He supposes that the extinction of such types was due to the feebleness of the latter construction, which precluded the attainment of any considerable speed on the part of its possessor. The types in which this expansion took place persisted, and became the ancestors of the existing forms. As an example, see Procamelus. (Fig. 10.)



A. B.

Fig. 9. Pes of Artiodactyla. A. *Merycochoerus montanus* Cope, two-fifths natural size. B. *Bos taurus.* L. one-fourth natural size.

The specialization of the elbow joint first becomes pronounced in the Artiodactyla in the Tragulidae. This consists in the development of the external part of the condyles of the humerus into a roller of contracted diameters, and separated from the remaining part of the condyles by a keel, or tongue. The roller and tongue work into a corresponding plane and groove of the head of the radius, forming an interlocking joint of great strength. The strength of the union between the radius and the ulna is increased by the development of a keel on the inferior side of the head of the former, which fits a groove on the upper side of the latter. Both of these structures can be traced from their beginnings in the Artiodactyla. (Plate V.)

Fig. 10.

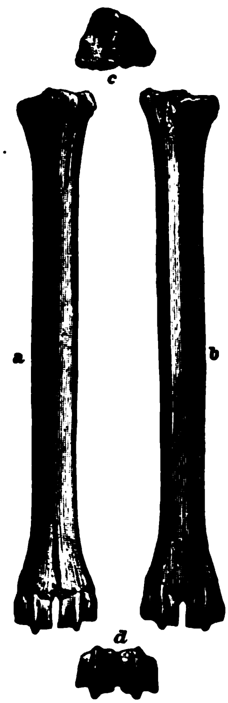


Fig. 11.

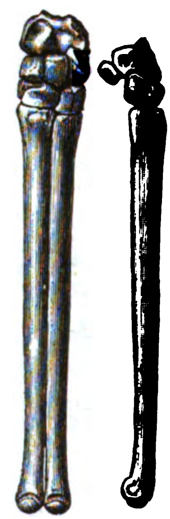


Fig. 12.

Fig. 10.—-Part of anterior foot of *Procamelus occidentalis* from New Mexico. From Report of of Capt. G. M. Wheeler, Vol. IV, Pt. II.

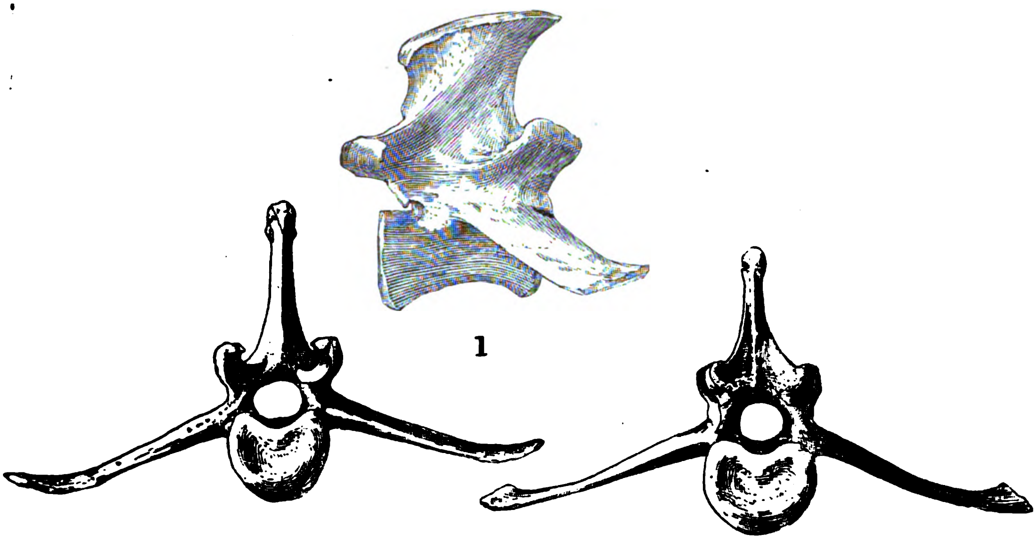
Fig. 11.—Metacarpals of *Cosoryx furcatus* from Nebraska, two thirds natural size ; *a*, anterior face; *b*, posterior ; *c*, proximal end ; *d*, distal end.

Fig. 12.—Left forefoot with part of radius of *Poebrotherium vilsoni* Leidy, from Colorado, three-fifths natural size. From Hayden's report (unpublished).

The trochlear keel or crest,[1] as the tongue of the humerus may be called, is first represented by a convexity of the roller, precisely as in the unguiculate

[1] The trochlear crest of the Artiodactyla is not homologous with the inter-trochlear crest of the Anthropomorpha.

PLATE IV.



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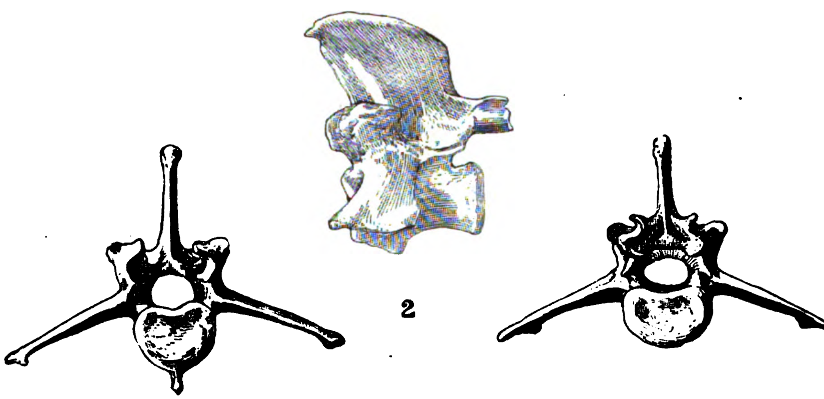

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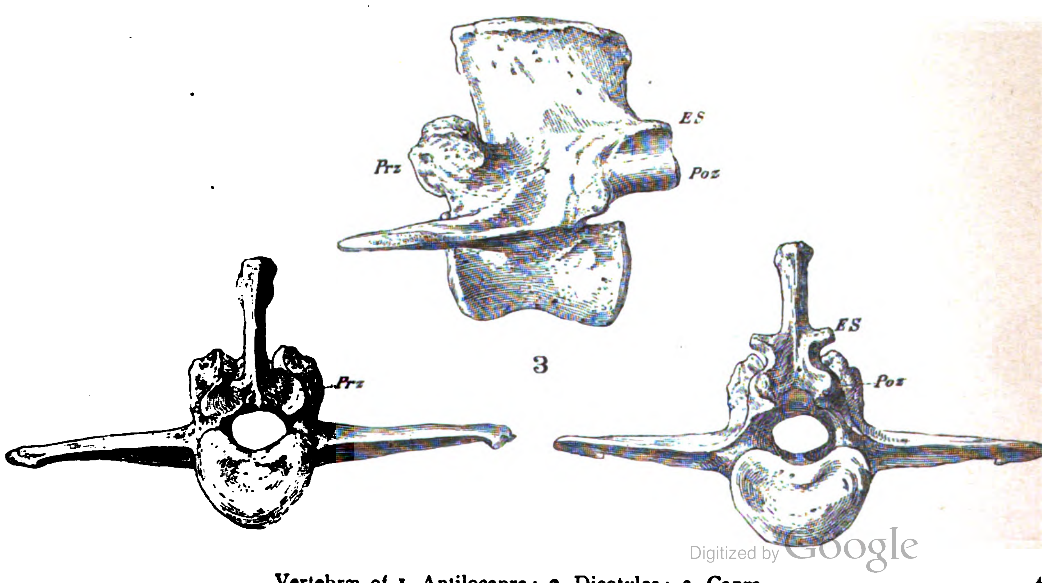


3

Vertebræ of 1. Antilocapra; 2. Dicotyles; 3. Capra.

mammals. (Plate IV. figs. A, D, Hyæna, Eucrotaphus.) With the compression of the external part of the condyle, the external slope becomes steeper and is at length nearly vertical (Ibid, fig. E, Cervus). The mechanical cause of this trochlear crest is the use of a single fore leg to support the body in rapid locomotion. As had been remarked by H. Allen, a modern Artiodactyle in rapid motion lights on one forefoot, which strikes the earth immediately on or even beyond a point below the middle of the body (fig. 13). This throws the impact principally on the external side of the humeral condyles, with the result stated. A similar cause produces a similiar result in the development of the tongue and groove articulation between the metapodials and first phalanges. In lighting on a didactyle foot, the toes are naturally spread, the result being to throw both the first phalanges away from the median line, or axis of impact, in divergent directions. The result of this impact is to produce on each metapodial condyle as in the case of the humerus, an external roller of smaller diameter than the rest of the condyle (fig. 11), and separated from it by an abrupt crest. In both humerus and metapodial bones these crests are accentuated by a pinching process during flexion and extension. This is produced by the longitudinal torsion which results in all limbs in motion from the arrest of the outward rotation of the foot by the earth, on alighting. The

FIG. 13—*Cervus canadensis* in motion, from behind. From the Muybridge photographs.

pinching of a keel by its groove takes place at all points in the length of the former reached by the opposite sides of the extremities of the latter during flexion and extension (fig. 14). This keel becomes acute and prominent in the Boöidea, and extends to the anterior face of the condyle fig. 11, *Cosoryx furcatus*). This development has been apparently especially due to the presence of two sesamoid bones, embedded in the flexor tendons, one on each side of the middle line of the posterior side of the metapodial condyle. The fissure between these bones has permitted the moulding of the surface into a keel to fit it. That this has been the case is further indicated by the fact that a single median trochlear surface exists at the distal extremity of the first phalange in all mammals. But a single flexor tendon crosses

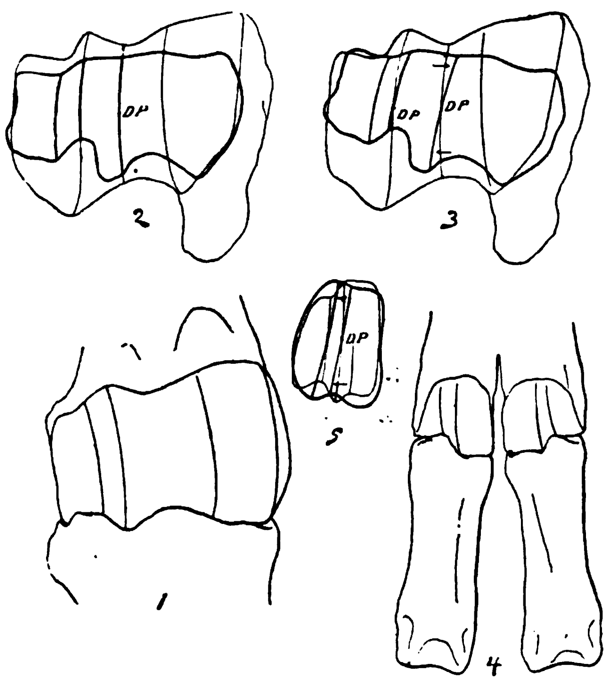


Fig. 14—Tongue and groove joints in *Cervus elaphus*. 1–3, elbow joint with trochlear keel and groove. 1–2, in place; 3, radius dislocated by external torsion. 4–5, metatarso-phalangeal articulation; 4, in place; 5, dislocated by torsion of phalange; *D P*, the dead or fixed point.

this articulation, and it contains but one sesamoid bone, to which the trochlear surface is moulded in a concave surface, as in the case of the patella and the rotular groove of the femur (figs. 8, 9B, 9, 10, 14).

The increased complexity of the intervertebral articulations,[1] is seen in the modifications in the shapes of the zygapophyses.[2] In reptiles the mutual articulating surfaces of these processes are horizontal and flat. In the lower Mammalia they are slightly oblique. In many Carnivora the obliquity is strongly marked, and a similar form is seen in the lower

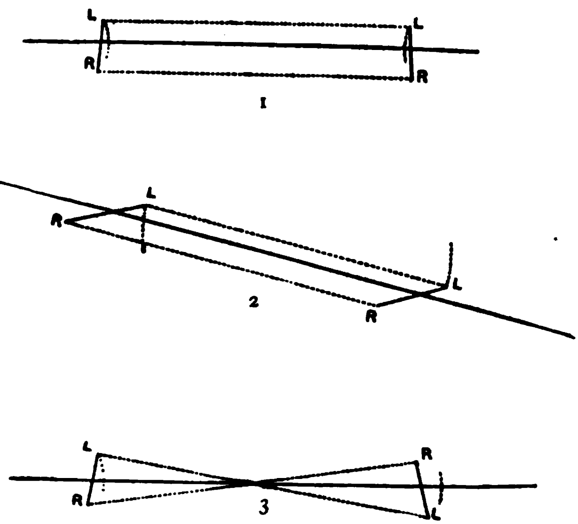


FIG. 15—Diagrams representing movements of the vertebral column in locomotion. 1. The pace; 2. the run; 3. the trot.

Diplarthra. As we ascend the scale of the latter, the prezygapophyses become involute and embrace the postzygapophyses above, as well as externally below (Plate IV., fig. 1, Antilocapra). This superior part of the prezygapophyses develops, and reaches the basis of the neural spine, with which it forms an articulation. The base of the spine expands

[1] For a tabular exhibit of these, see Proceedings Amer. Ass. Adv. Science, 1883; Origin of the Fittest, 1885.

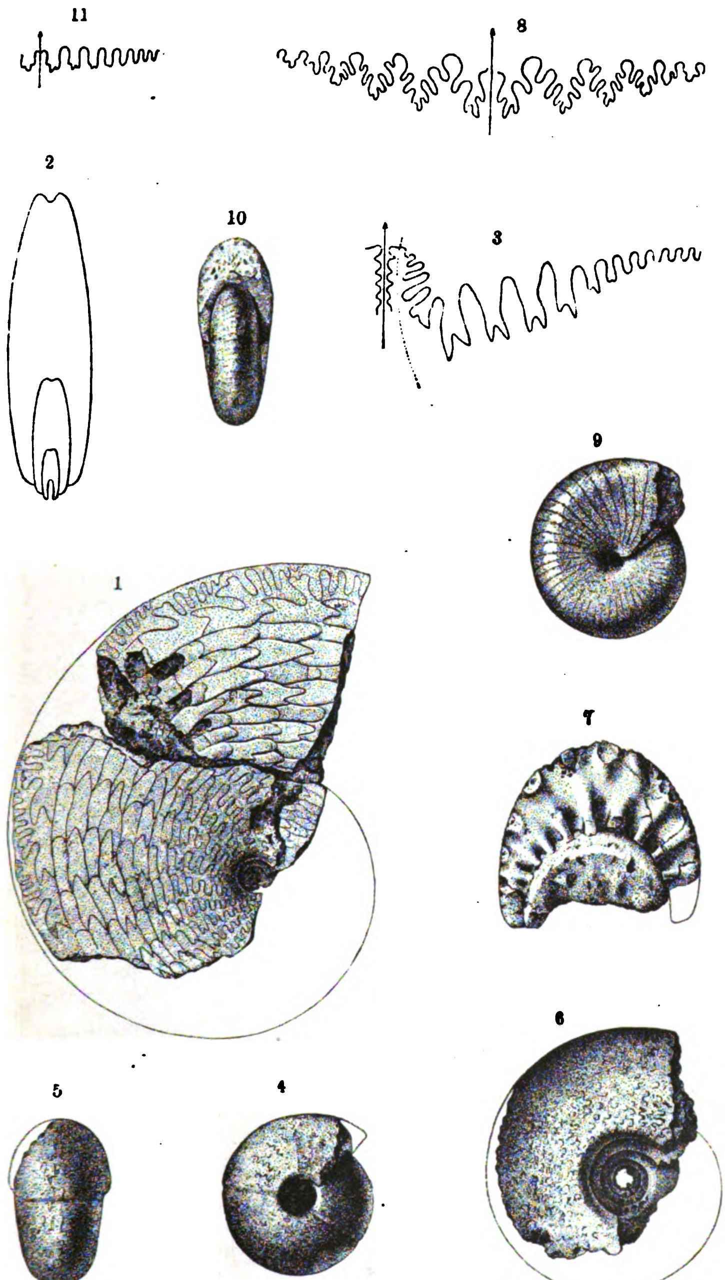
[2] On torsion in locomotion. See art. Perissodactyla, NATURALIST, 1888, 988, 1073.

above this articulation, forming a second process above the postzygapophysis, the episphen. This occurs in the Suoidea and the Boöidea (Plate IV., figs. 2 and 3, Dicotyles and Capra).

The mechanical explanation of the origin of this structure is probably found in the nature of the movement of that part of the vertebral column which is between the limbs during progression; and especially of the more flexible region (lumbar) which is posterior to the ribs. All the gaits of quadrupeds may be reduced to three types, and their varieties. In the first, the extremities of the column are alternately elevated and depressed, without lateral motion. This is seen in the run. In the second, the sides of the column are alternately elevated and depressed. This is seen when the limbs of one side move simultaneously, as in the pace. In the third type, limbs of opposite sides of opposite extremities, move together, as in the walk and trot. The effect of this movement is to twist the column in its long axis. These effects are diagrammatically represented in the accompanying figure 15. It is this torsion which has produced the involuted zygapophyses, and later the episphen. It should be the fact that animals which display this structure should walk and trot, while others should pace and run. And this is the case. The trot as a habitual gait is especially characteristic of the Diplarthra. The Proboscidia and Carnivora pace, although the dogs frequently trot as well. We must suppose that the trot was the favorite gait of the Creodonta, since they possess the involuted zygapophyses.

The only genus certainly referable to the DICHODONTIDÆ, is the Dichodon Owen, from the upper Eocene of England. In this form we have the earliest quadriselenodont molars, the intermediate fifth crescent having disappeared The first superior premolar is like a true molar, while the first inferior is trilobate (Kowalevsky; molariform, Owen). The other premolars are very elongate and compressed, resembling those of Xiphodon. This resemblance is heightened by the incisiform shape of the canines, and the uninterrupted dental series. In the same beds occur limb and foot bones which probably belong to Dichodon (Schlosser) which are didactyle, but in

PLATE I.



Permian Cephalopoda.

which the fusion of the trapezoides and magnum in the tarsus, has not yet taken place. The metapodials then rest on a single carpal or tarsal bone each, instead of on two, as in modern didactyle genera, representing the inadaptive type of Kowalevsky. *Dichodon cuspidatus* is about the size of a fallow-deer. Smaller species have been found in Germany. The genus is probably represented in North America by Stibarus Cope, of the White River bed. I have associated provisionally with the Dichodontidæ two North American genera, Agriochoerus Leidy (Plate III.), and Coloreodon Cope (fig. 5). These genera differ from Dichodon in having the first premolars in both jaws molariform or nearly so, and in having the other ones much less compressed, except the fourth inferior, which is caniniform, as in Oreodon. There are four premolars and little or no diastema in Agriochoerus, and three premolars and a long diastema in Coloredon. The former possesses six species, which are equally divided between the White River and John Day beds, and the latter, two species from the John Day Miocene. Their feet are unknown.

The remaining families of the Cameloidea are the Poëbrotheriidæ, Protolabididæ, Camelidæ and Eschatiidæ. I have already described their characters in the pages of the NATURALIST.[1] I will only add to that account the interesting discovery made by Profs. Scott and Osborn, of a third genus of Poëbrotheriidae which they call Leptotragulus. It differs from Poëbrotherium and Gomphotherium, in the separate condition of the ulna and radius.[2] It is from the highest Eocene beds of Utah (Brown's Park, or Uinta system), and thus stands in ancestral relation to Poëbrotherium.

The Cameloid phylum presents a noteworthy peculiarity. The Poëbrotheriidæ have acute trihedral ungual phalanges like those of most other Artiodactyla. In the Camelidæ, including the extinct genus Procamelus, the ungual phalanges are short and obtuse, and apparently undergoing atrophy. This form is associated with the presence of a cushion of connective tissue on the inferior side of the phalanges, which

[1] 1886, p. 611: The Phylogeny of the Camelidæ.

[2] My knowledge of this genus is entirely derived from the unpublished mss. of Profs. Scott and Osborn.

supports the weight of the animal, thus removing it from the ungues. This cushion has relieved the metapodials from impacts and torsion, a fact which I have regarded as explaining the absence of the trochlear keel from the extremity and front of those elements in the Camelidæ. We must then suppose that the development of the elastic foot-pad of the camels began in the Miocene period before this character appears, and caused a divergence from the Booid line in the foot structure. This divergence probably took place before the development of the third stomach, and the addition of water compartments in the paunch may be supposed to have commenced at about the same time.

Existing Camelidæ pace, yet they have more or less distinct episphenal processes to the vertebræ. These are distinctly visible in Procamelus. We must suppose that their ancestors, as the Poëbrotheriidæ, were trotters, and that the habit has been changed in later periods.

With the TRAGULIDÆ we commence the great, mostly modern division of the Boöidea, or Ruminantia. As already related, most of the characteristic peculiarities of the specialized Artiodactyla commence with this family. The trochlear cylinder and crest of the humerus appear here for the first time, for the Suoid and Cameloid series never develop more than traces of either. The naviculocuboid bone is characteristic. How variable the conditions of the other bones of the limbs are in the Tragulidæ may be gathered from the accompanying table. A few species of two genera, Dorcatherium and Tragulus, still exist in the warm parts of Africa and Asia. These agree with the Camelidæ in the absence of the third stomach, the other three being present.

I. Both metatarsals and metacarpals distinct; molars brachyodont (Hypertragulinæ).

a. Lateral toes behind.

Anterior internal cresent of inferior molars represented by a conical cusp. .... *Lophiomeryx* Pom.

Interior cresents of inferior molars developed .... *Dorcatherium* Kaup.

aa. No lateral toes behind.

Diastemata in both iaws .... *Hypertragulus* Cope.

II. Metatarsals forming a cannon bone; metacarpals distinct; molars brachyodont (Gelocinæ).

a. Lateral digits of the manus, none of the pes.

Superior premolars with a small internal tubercle.............. *Leptomeryx* Leidy.

aa. No lateral digits.

Four lower premolars.. *Gelocus* Aym.

Three lower premolars............ .... *Bachitherium* Filhol.

III. A metatarsal cannon bone; metacarpals forming a cannon bone; molars brachyodont (Tragulinæ).

a. Lateral digits well developed.

Premolars entirely simple.................................. *Tragulus* Briss.

aa. Lateral digits weak.

Four inferior premolars, the posterior with branch ridges; superior premolar 3 with strong cingulum........................... *Amphitragulus* Pomel.

Three inferior premolars, the posterior with branch ridges; superior premolar 3 with strong cingulum, elongate.... .... *Prodremotherium* Filhol.

IV. Metatarsals and metacarpals unknown; molars hypsodont (Hypisodontinæ).

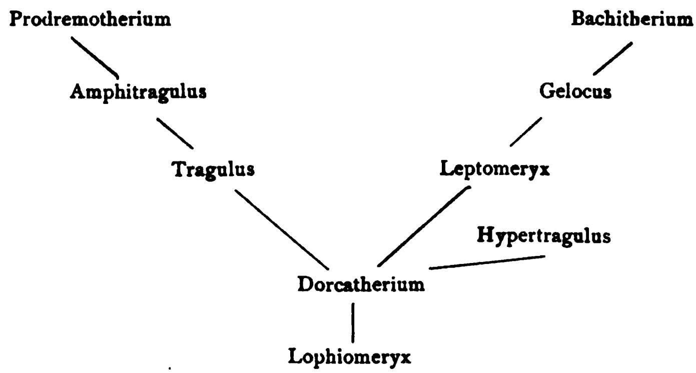
A diastema behind p. m. 2: canines below not distinct from incisors.
.... *Hypisodus* Cope.

Dorcatherium, an existing genus, has four well developed digits, and is nearest the Oreodontidæ. The only difference between that family and the present one being the presence and absence of the naviculocuboid bone respectively, Dorcatherium must be placed on the Traguloid side of the line. Probably extinct genera will be found which will connect this genus more intimately with the Oreodontidæ, for the slight complication of the premolars of extinct genera of the latter, testify to earlier members with simpler ones.

Lophiomeryx and Hypertragulus must be associated with Dorcatherium on account of the lack of cannon bone. Lophiomeryx has an inferior type of inferior true molar, and like Dorcatherium has four toes on all the feet. Hypertragulus displays greater specialization in the absence of lateral digits from the posterior feet. The ulna is also coössified with the radius, and there is a naviculocuboid bone. The premolar teeth are nevertheless very simple, and are separated by diastemata in both jaws. It must be regarded as a modified descendant of Dorcatherium on one side of the main line of descent. (Plate VI.)

In the next group the metatarsals have united while the metacarpals remain separate. This is the case in Leptomeryx of the American Oligocene. In Tragulus the premolars are much simpler than those of the other genera of Section III,

and simpler than those of Leptomeryx, so that these two forms must have been derived from an ancestor which combined the simplicity of both forms. For this we must again recur to Dorcatherium, and I therefore insert this genus at the base of the following diagram. With its entirely prismatic molars Hypisodus has one element of superiority, but the number of its superior premolars is unknown.

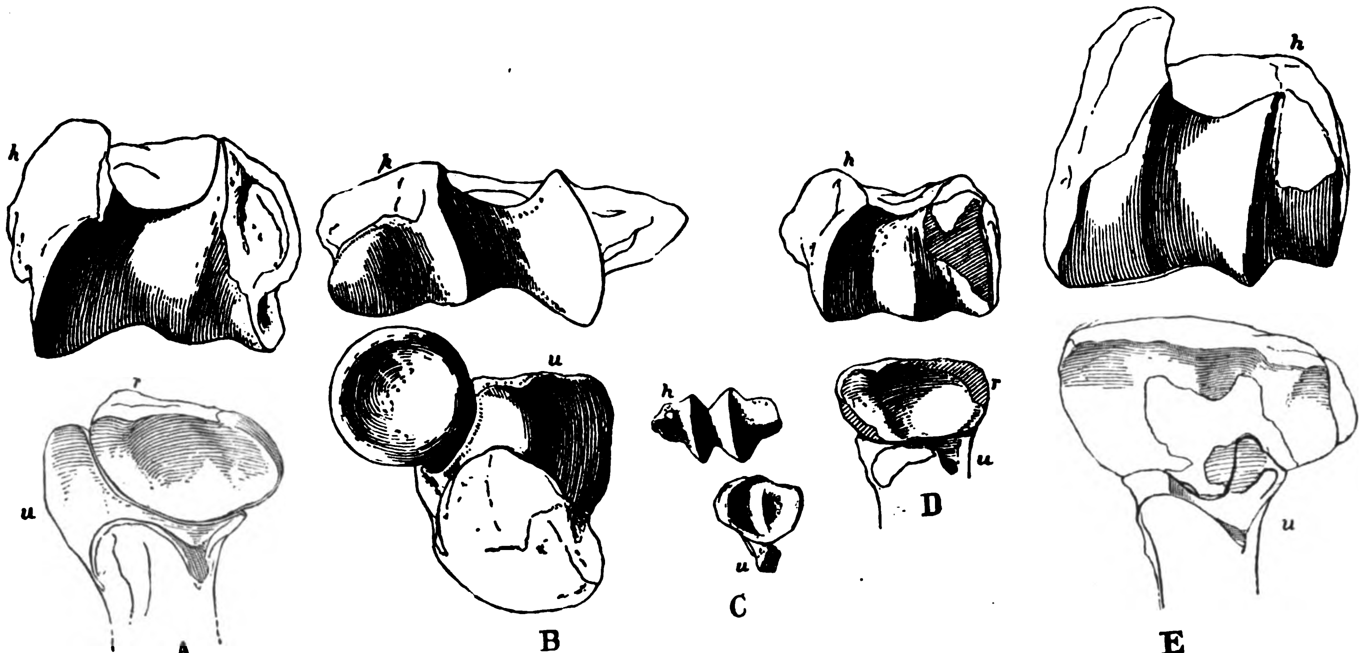


Two species of this family are very abundant in the Cænozoic beds of North America. These are the *Leptomeryx evansi* Leidy of the White River series, and the *Hypertragulus calcaratus* Cope of the same, and of the John Day Miocene series. Either species was of the size of a spaniel, and had delicately formed limbs. The *H. calcaratus* had large eyes, and a compressed muzzle. Larger species are found in Canadian beds. The least species of the family belongs also to the White River Beds. This is the *Hypisodus minimus* Cope, whose size does not exceed that of a gray-squirrel. Like the Leptomeryx, it does not extend upwards into the John Day beds.

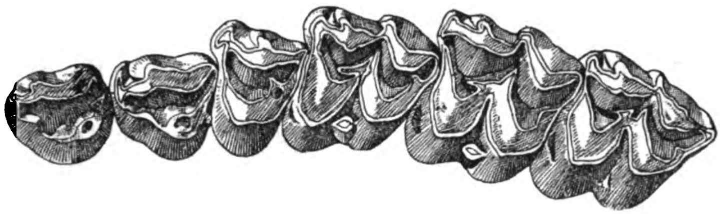
The remaining families of the Boöidea agree in possessing the following characters.

The second and generally the third superior premolar teeth possess an internal crest as well as the fourth fig. 16). The inferior premolar teeth have oblique transverse crests. The keel of the distal extremity of the metapodial bones extends to the front of the condyle (fig. 11). The lateral metapodials are represented by their extremities only, the middle

PLATE V.



Elbow joints of A, Hyæna; B, Simia; C, Rhinolophus; D, Eucrotaphus; E, Cervus.



(FIG. 16.) *Blastomeryx borealis*, Cope, superior molars natural size. From Ticholeptus bed of Montana. Original.

portion having disappeared (fig. 8–5). The median pair are united into a cannon bone. There are no superior incisors. The odontoid process of the axis vertebra is trough-shaped. The stomach is divided into four parts.

The lowest family of the series is that of the Moschidæ. In its hard parts it differs from the Bovidæ in the simplicity of the anterior third superior premolar, which is without the internal crescent found in the other Boöidea. In this respect it is intermediate between that division and the Cameloidea, where the first premolar only possesses the internal crescent. But two genera of Moschidæ are known, Dremotherium from the Lower Miocene of France, and the living Moschus. Both lack horns and have well developed canine teeth. The origin of this group is clearly from the Tragulidæ, and the genus of that family which approaches nearest to it is Amphitragulus, which indeed only differs from it in dentition in the imperfection of the internal crest of the second superior premolar. In turn, Dremotherium must be regarded as ancestral to Palæomeryx, the most primitive genus of the Bovidæ.

The Giraffidæ differ (see table of families) in the mode of attachment of the horns. These are originally separate from the skull, but become attached to it like the epiphyses on the extremities of the bones of the skeleton. Their dental characters are like those of the Cervidæ and the lower Bovidæ, the molars being short crowned or brachyodont. It may be that the condition of the horns in Giraffa represents the mode of origin of the horns of the Bovidæ,[1] and that the genus is simply to be reckoned a primitive type in that family. The

[1] In the sheep the horns begin as bodies separate from the skull.

specialization of the long neck and fore legs would not exclude it from that family. It is merely an adaptation for the habit of browsing on the foliage of tall trees. In the extinct species of its single genus, Giraffa, these characters are found in a less degree than in the existing one, forming transitions to the ordinary forms of Boöidea.

The most obvious distinction between the Bovidæ and the Cervidæ is in the differing character of the bony processes of the skull, used for offense and defense. But where horns are wanting, as is the case with some genera, these distinctions fall to the ground. The horn-type of the Bovidæ is more primitive than that of the Cervidæ, since the horny process is permanent in the former, and is shed and reproduced annually in the latter. The dental type is, however, never so specialized in the deer as is the case with the highest genera of Bovidæ, remaining always distinctly rooted, while in Bos and some other genera of the latter they become prismatic. But the lower genera of Bovidæ do not differ from Cervidæ in this respect.

In accordance with these facts the bovine ruminants appear a little before the cervine, though authors generally refer the earliest genera to the latter division. Such are the genera Dicrocerus and Cosoryx,[1] which appear in the latest Miocene beds. Dicrocerus only differs from Palæomeryx in the possession of horns, which resemble those of deer, but which were, according to Schlosser, never shed, a fact which compels its location in the Bovidæ. In Cosoryx the horns have the same character in this respect, but the teeth are antelopine, or prismatic. It is clearly to be placed in the Bovidæ with Antilocapra (the prong horn,) and it is closely allied to Dicrocerus. Here we see that the point of origin of the two families was from a common ancestor, and that this ancestor was, as has been already expressed by Schlosser, the genus Palæomeryx. Nearly related to this point of departure are the Sivatherium, Bramatherium, and Hydaspidotherium. As they did not shed their horns, they cannot be referred to the Cervidæ. In their covering with the integument, Cosoryx probably possessed a character of Giraffa, which is a primitive

[1] Leidy, Cope; Procervulus Gaudry.

(FIG. 17.) *Dicrocerus furcatus*, posterior part of skull, one-fourth natural size. Miocene, France. From Gaudry.

stage of the essential character of the horns of the Bovidæ. Perhaps the retention of the primitive dermal character of this investment, instead of its metamorphosis into horn, might be regarded as a basis for a distinct family, the Cosorycidæ. But it is highly improbable that this covering remained in Sivatherium and Bramatherium, whose horns were apparently perfectly naked. It is not evident how all these animals can be retained as distinct from the Bovidæ, and I therefore place them in two subfamilies of that family. The Cosorycinæ, which will include Cosoryx and Blastomeryx, are characterized by the sheath of the horns being dermal; the Sivatheriinæ by the absence of any sheath whatever. The synopsis of genera will then be as follows:

I. No horns in the male.

Molars brachyodont .... *Palæomeryx*[1] Von Meyer.

II. Horns covered with skin (Cosorycinæ).

Teeth brachyodont; no frontal excrescence .... *Blastomeryx* Cope.

Teeth prismatic; no frontal excrescence .... *Cosoryx* Leidy.

III. Horns naked (Sivatheriinæ).

Teeth brachyodont; two pairs of horns, all separate ..... *Sivatherium* Cautl. Falc.

Teeth brachyodont; two pairs of horns; those of the anterior pair from a common base .... *Bramatherium* Cautl. Falc.

Teeth brachyodont; one pair of horns, from distinct bases .... *Dicrocerus* Lart.

IV. Horns covered with a horny sheath; teeth hypsodont (Bovinæ).

a. No internal column of true molars.

β. No lateral ungues. (Nasal bones normal; postzygapophyses single).

Horn-sheath furcate .... *Antilocapra* Ord.

Horn-sheath simple .... *Nanotragus* Sund.

[1] Should *P. eminens*, type of Palæomeryx, have possessed horns, as suspected by Schlosser, the generic name must take the place of Dicrocerus below, and be replaced by one of the various names which apply to hornless species.

ββ. Lateral ungues present.

γ. Nasal bones separated from maxillary and lachrymal bones.

Horns simple, one pair..*Saga* Gray.

γγ. Nasal bones more or less in contact with lachrymal or maxillary bones.

δ. Lumbar postzygapophyses single. (Numerous species not examined)

ε. Inferior premolars three.

Horns one pair..*Antidorcas* Gray.

εε. Inferior premolars four.

Horns two pair..*Tetracerus* H. Smith.

Horns one pair; last inferior molar with four columns...........*Neotragus*[1] Gray.

Horns one pair; last inferior molar with five columns.............*Ovis*[2] H. Smith.

δδ. Lumbar postzygapophyses double.

Horns one pair; inf. mol. 3 with five columns......................*Capra* Linn.

αα. One or more superior true molars with a median internal column.

Lumbar postzygapophyses single..........................*Ægocerus* H. Sm.

Lumbar postzygapophyses double................................*Bos*.[4] Linn.

A great number of names have been given to groups of species of the Bovinæ, especially within the limits of the genus Ovis of H. Smith. Here the various forms of sheep and antelopes have been distinguished as genera, and named accordingly. So far as concerns the skeleton, further subdivisions than those indicated in the above table do not appear to exist, and none have been pointed out. The divisions proposed appear to be rather those of one extensive genus. The modifications of the skull have reference to the position of the horns. These are processes of the frontal bones, and are placed at points from above the eye to the posterior angle of the facial plane of the skull. In the latter case this angle approaches very near to the supraoccipital crest or inion, and the parietal bone is reduced to an exceedingly narrow band between the frontal and occipital bones (Rütimeyer).[5] Forms with anterior horns and well developed parietal bones are *Ovis gazella* and *Tetracerus quadricornis*; while the *Ovis gnu*

[1] *N. saltianus* type. This character is derived from authority to which I cannot now refer. I have not seen it.

[2] Includes the following supposed genera: Antilope, Gazella, Cervicapra, Oreotragus, Cephalophus, Strepsicerus, Damalis, Alcelaphus, Nemorrhædus, Rapicapra, Caloblepas, Haplocerus, Ovis, and Anoa.

[3] Includes the following supposed genera: Eleotragus, Ægocerus, Oryx, Addax and Portax.

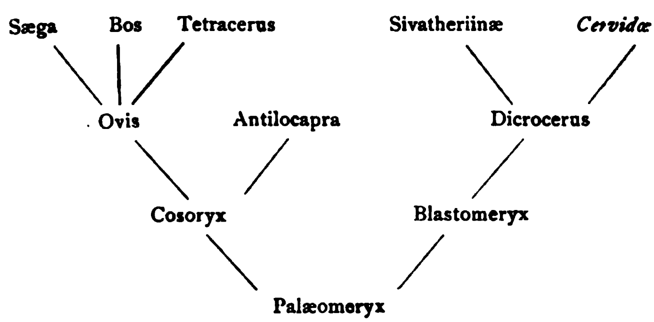
[4] In *Bos americanus* the postzygapophyses are single except on the last lumbar.

[5] Die Rinder der Tertiär-Epoche; Abh. Schwieiz. Pal. Gess., v, 1878.

displays the parietal extremely reduced, and become chiefly lateral in position. As regards the forms of the horns themselves, they present no important differences, but are angular and revolute in the section Ovis, and cylindric in the division Antilope. In the latter they vary in direction from straight to spiral or curved in different directions. Within the genus Ovis the end of the muzzle is naked or hairy, the latter in the typical forms and in those inhabiting northern and alpine localities generally. Those species that inhabit grassy or desert plains have the end of the nose naked.

Within the genus Bos modifications are observed parallel to those in the genus Ovis. The frontal bones with the horn processes are produced more and more posteriorly until the parietal bones are reduced to a narrow band across the posterior part of the skull. The bisons have the horns most anterior; then follow the buffalos, and the extreme is reached in the true oxen, of which the domesticated animal is the type.

The following table will give an idea of the phylogeny of the Bovidæ.



The hornless Palæomeryx has given origin to the horned Boöidea; on the one hand to the brachyodont (Blastomeryx, etc.), and on the other to the hypsodonts (Cosoryx, etc.). A cornification of the integument in a fork horned Cosoryx produced Antilocapra, while the same process in a simple-horned Cosoryx, produced Ovis. The development of this type has undergone the three principal modifications indicated by the three genera which succeed upwards. In Sæga an extra-

ordinary development of the muzzle takes place, which causes a change in the relations of the nasal bones. In Tetracerus another pair of horns is developed in front of the usual pair. Bos developes complications of the molar teeth in both jaws.

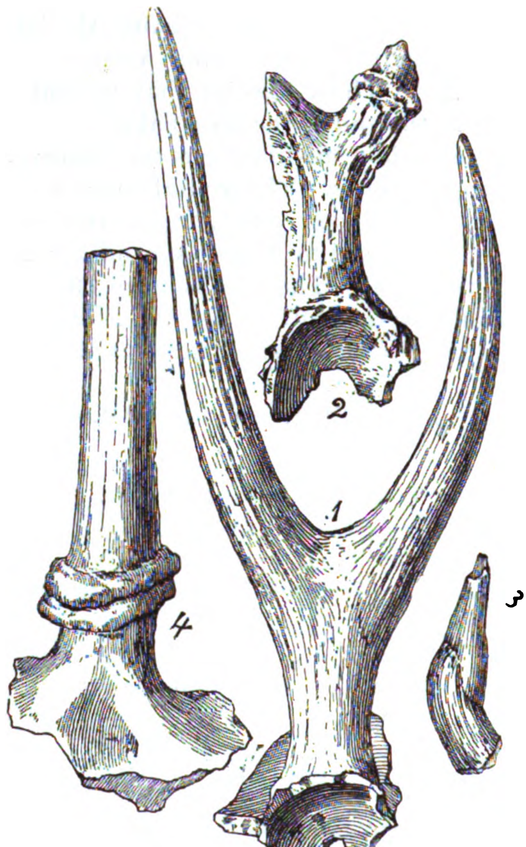


FIG. 18.—Cosoryx horns, three-quarters natural size, showing burrs and repaired fracture. Figs. 1-2, *C. necatus* Leidy. Figs. 3-4, *C ramosus* Cope. From the Loup Fork Miocene of New Mexico. From Report U. S. G. G. Surv. w. of 100 meridian.

On the brachyodont side the development of the dermal covering of the horns of Blastomeryx is arrested, and naked horned types follow. In the Sivatheriine group no further

change follows except complication of the horns. In the Cervine group, on the contrary, the habit of shedding them becomes fixed, and a new family has its origin.

No species certainly referable to Palæomeryx or Dicrocerus have been as yet found in North America, but they may be detected at any time. Numerous species have been found in Europe. Cosoryx is abundant in North America, six species being known (fig. 18, *C. necatus and C. ramosus*). They vary in size from that of a gazelle to that of a

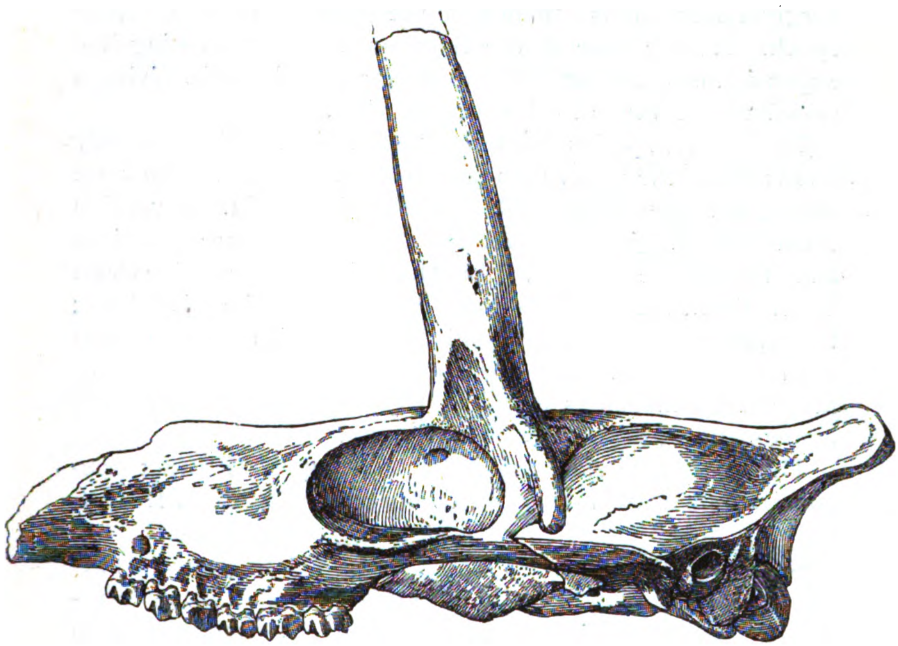


FIG. 19—***Blastomeryx borealis*** **Cope, one-sixth nat. size. From Ticholeptus bed of Montana; original.**

fallow-deer. Although they did not shed their horns, some individuals developed a burr near the base of the beam, and burrs are found on the branches followed by broken down bone (Figs. 18, 2). In other cases broken points of antlers have become reattached, showing the presence of an integument to retain them. I have suggested that the development of the burr was due to the stripping or laceration of this integu-

ment to and at the base of the beam, producing an engorgement of the vessels and deposit of calcic phosphate; and that the stripping of the horns when complete resulted in their death and subsequent sloughing, thus originating the periodical shedding of the horns characteristic of the deer. This periodicity would depend on the periodicity of the season of reproduction, when the horns are especially used in conflicts between the males (Fig. 17).

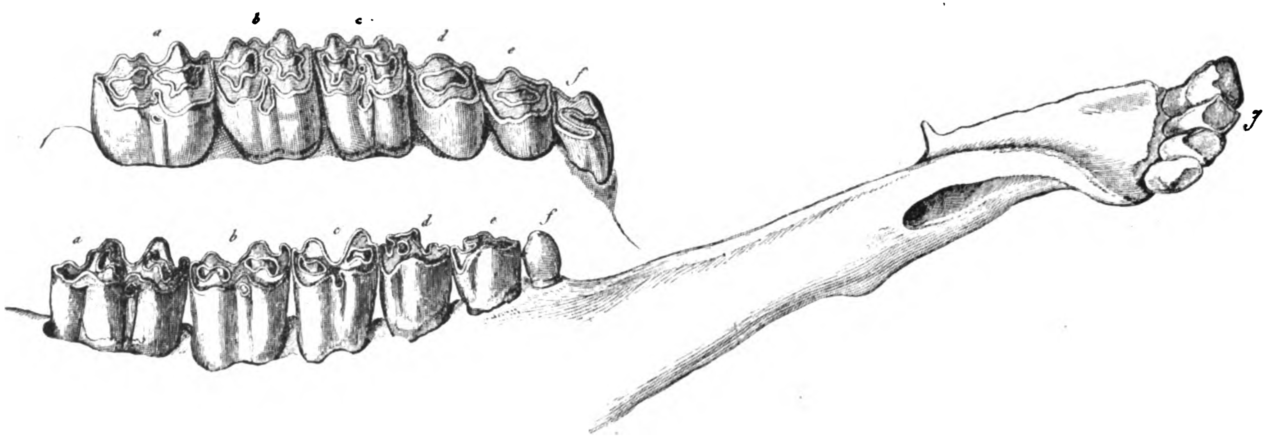
Two species of Blastomeryx are known, a smaller, and a larger (*B. borealis*, Fig. 19), which was about the size of the Virginia deer. It is common in the beds of the Ticholeptus epoch. At the base of the horn on each side, a wing-like expansion extends outwards posterior to the orbit, giving a peculiar appearance to the anterior view.

The extinct species belonging to the Sivatheriinæ are only known from the upper Cænozoic beds of India, and they are among the most remarkable of the Artiodactyla. Several of them were of gigantic size, and their horns were of curious and formidable shapes. In the *Sivatherium giganteum* Cautl. Falc., the fore legs were longer than the hind legs; the forehead was concave, and furnished with a supraorbital horn on each side. The posterior horns were broadly palmate, and the muzzle is supposed to have been produced and convex above, as in the moose (Fig. 20).

The smaller Bovidæ are called Antelopes. Extinct species are numerous in the upper Cænozoic formations of Europe and Asia, but they are wanting from corresponding beds in North America. The European species are related only subgenerically to those now existing in central and south Africa. All sorts of grada-

Fig. 20—*Sivatherium giganteum* C. F. cranium from front, much reduced. From Falconer. Miocene, India.

PLATE VII.



Bos taurus (from Cuvier.)

tions leading to the true genus Bos are found, especially in India, where many species of large size and various development of horns have been found. It appears that Bos is a polyphyletic genus, the divisions known as Bison, Bubalus and Bos, having arisen from as many types of Antelopes, which resemble them in the positions of the horns. In North America the division Bison only has been found, and this in Plistocene beds. Such are the species *Bos alleni* Marsh, and *B. latifrons* of Harlan. The latter species was of large size, the horn-cores of some specimens being as thick as a man's leg. It is evident that the line of the Boöidea was not continuous in North America, but that its later representatives were derived from the old world.

The following series may approximate a correct representation of the phylogeny of the genus Bos, expressed in genera.

Bos Ovis (sens. lat.) Cosoryx Palæomeryx	Bovidæ.
Dremotherium	Moschidæ.
Amphitragulus Gelocus Leptomeryx Dorcatherium	Tragulidæ.
*	
Anthracotherium Cebochœrus	Anthracotheriidæ.
*	
Pantolestes	Pantolestidæ.

Of the Cervidæ or the Boöidea which shed their horns, the genus Cervus is one of the earliest with which we are acquainted. Undoubted species of the genus occur in the Pliocene, and Upper Miocene species are also referred to it. As species from the Lower Pliocene (*C. matheroni* Gerv.) are referred to Capreolus, those of the Miocene may not be true Cervi. Their structure is not sufficiently known to determine this point. The arrangement of the genera is as follows. The three primary divisions were established by Brooke.

I Lateral metapodials complete only distally, and supporting dewclaws (Telemetcarpi).

a. Nasal passages posteriorly two, separated by vomer (Cariaci).

Horns simple spikes........ *Coassus* Gray.
Horns more or less furcate........ *Cariacus* Gray.
Horns palmate........ *Rangifer* H. Smith.

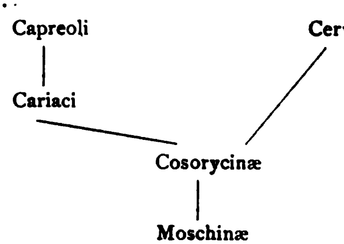
aa. Nasal passage posteriorly one, not divided (Capreoli).

No horns........ *Hydropotes* Swinh.
Horns furcate; no postantler........ *Capreolus* Gray.
Horns palmate; no postantler........ *Alces* H. Smith.
Horns palmate; a postantler........ *Cervalces* Scott.

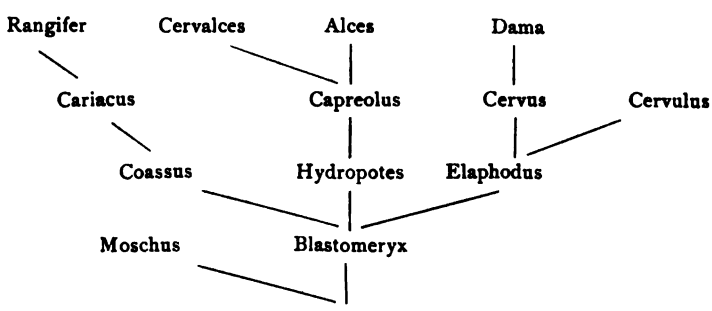
II. Lateral metapodials represented by proximal splints only; nasal passage not divided (Plesiometacarpi). (Cervi).

Frontal cutaneous glands; horns furcate........ *Cervulus* Blv.
No frontal glands; horns simple........ *Elaphodus* M. Edw
No frontal glands; horns furcate........ *Cervus* Linn.
No frontal glands; horns palmate........ *Dama* H. Smith.
Horns furcate; brow antler greatly exceeding beam, (Gill)... *Elaphurus* M. Edw.

The phylogeny of these genera cannot be fully known until the skeletons of the extinct genera and species have been obtained. It is, however, certain that the short series of genera included in each of the three divisions (II *a* and *aa*, III) are genetic series; and also that division I is ancestral to both II and III, although perhaps by an extinct genus differing in some respects from Moschus. These relations can be thus expressed:



or thus:



Each of the genetic series commences with a genus with no or with very simple horns. The next genus or stage presents branched horns, sometimes of great complexity. The last term in each is the palmate horn, where a greater or less number of the tines unite to form a plate. These series, as is well known, correspond with the history of the growth of the horns in successive years of the life of each species.(Fig. 21.)

None of the genera of this family are extinct except Cervalces Scott.

The true Cervidæ form a family of very recent origin, and only distinguished at the period when forms like Cosoryx and Dicrocerus began to shed their horns. Dicrocerus is repre-

FIG. 21. Horns of *Cervus elaphus* from the second to the sixth years inclusive. From Cuvier.

sented by several species in the middle Miocene of Europe, and their horns are mostly bifurcate as in the third year's horn of a true deer. In the middle Miocene and part of the Pliocene the horns have three antlers as in the fourth year of Cervus, and as is permanent in the genus or section Rusa of tropical Asia.

The many branched horns appear in the Pliocene and Plistocene in Europe, in numerous species. In America extinct Cervidæ are more abundant than Bovidæ. Several species occur in the Pliocene beds of Buenos Ayres, and of Washington. The latter are related to the Moose (*Alces brevitrabalis* Cope) and American deer, (*Cariacus ensifer* Cope.) A very

remarkable species occurs in the Plistocene beds of the eastern region, the *Cervalces americanus* Harlan. Its affinities are with the Moose, with which it agrees nearly in size; but it differs in possessing a posterior branch to the horn, which forms a broad, curved plate extending outwards above and behind the orbit, which resembles somewhat a hearing trumpet.

ADDENDUM.

In the first part of this article in the NATURALIST for December, 1888, p. 1088, I have given the characters of the subfamily, Dicotylinæ, of the family Hippopotamidæ, and of the two included genera, Dicotyles and Platygonus. Some amendment of these definitions is necessary, as follows: That of the sub-family "Digits three" should be supplemented by the words,—on the anterior foot, and four on the posterior. The genera are both stated to have premolar teeth similar to the true molars. This statement must be qualified as regards the species now referred to Dicotyles, and must be contradicted as regards Platygonus. In the latter genus the deciduous premolars only resemble the true molars (fig. 6, p. 1093), and they have the peculiarity of remaining in the jaw until the last true molar is nearly protruded. In Dicotyles, the deciduous teeth have disappeared before the last true molar is protruded. The permanent premolars are, as Leidy has described them, generally simpler than the true molars, consisting of two external, and one internal tubercle.

But the species differ so much in the characters of their premolars that they can be referred to three subdivisions, which may be at some future time regarded as genera. These are as follows:

I. Premolars all different from molars (*Notophorus* Gray); *D. tajassus*.

II. Last premolar only, like the molars (*Dicotyles* Cuv.); *D. labiatus* Cuv.; *D. serus* Cope; *D. angulatus* Cope.[1]

III. Second premolar (from front) like true molars (*Mylohyus* Cope); *D. nasutus* Leidy.

It is uncertain whether the complex premolar of *D. nasutus*

[1] AMERICAN NATURALIST, Feb. 1889.

is the penultimate or the last premolar. If it is the last, the genus Mylohyus will be distinguished by the presence of only two premolars.

An examination of the crania of *Dicotyles tajassus* in the U. S. National Museum from Costa Rica, shows that they display characters intermediate between the Brazilian typical form, and the *D. angulatus* of Texas. The last premolar teeth are sometimes premolariform, and less frequently approach the molariform structure. The facial angle is continued to the position of the canine aveolus, and the ridge of the maxillary bone is only separated from its border by a groove, not a fossa. The nasal bones are not tectiform. In general the characters agree with the *D. tajassus*, but the lateral facial angle is as in *D. angulatus*, and occasionally the last premolar resembles that of the same species. It appears then that the latter must be regarded as a subspecies rather than a species.

EXPLANATION OF PLATES.

PLATE III.

Agriochœr s guyotianus Cope, skull, natural size; from side, and one-half from below. From the John Day Bed of Oregon. Original from unpublished plate in Report of U.S. Geol. Survey Terrs.

PLATE IV.

The elbow joint of Mammalia, separated, and seen from above and posteriorly. A, *Crocuta maculata*. B, *Simia nigra*. C, *Rhinolophus* sp. D, *Eucrotaphus pacificus*. E, *Cervus elaphus*. All four-fifths natural size.

PLATE V.

Vertebræ of Artiodactyla, two-thirds natural size. Fig. 1 *Antilocapra americana;* 2, *Dicotyles angulatus;* 3, *Capra hircus*. *Prz* prezygapoplysis; *Poz* postzygapoplysis; E.S. Episphen.

Plate VI.

Hypertragulus calcaratus Cope, skull, natural size ; from the lower Miocene. Fig. 1, lower jaw from above, of specimen from White River bed of Colorado. Fig. 2, skull from John Day series of Oregon ; *a*, side, *b*, from above, *c*, from below.

Plate VII.

Bos taurus, dentition, two-thirds natural size ; from Cuvier.

EDITOR'S TABLE.

EDITORS E. D. COPE, AND J. S. KINGSLEY.

The position of the Post-Darwinians is clearly set forth in an abstract of a lecture delivered by Prof. E. Ray Lankester, at the London Institution, which appears in *Nature* of February, 28th. Prof. Lankester declares that the error of Lamarck (and consequently of the Neolamarckians,) consists in the assumption that acquired characters can be inherited. He says, "Congenital variation is an admitted and demonstrable fact; transmission of congenital variations is also an admitted and demonstrable fact. Change of structure acquired during life—as stated by Lamarck—is also a fact, though very limited. But the transmission of these latter changes to offspring is not proved experimentally ; all experiment tends to prove that they cannot be transmitted." Two inferences may be derived from these statements. First ; the author of them does not believe that the so-called congenital variations can be or have been acquired ; second ; that he has no hypothesis to offer in explanation of the origin of congenital variations. These positions exclude another inference which nevertheless may be derived from other propositions embraced in the abstract of the lecture. He says, with Lamarck, that "change of structure acquired during life is also a fact," and also that "all plants and animals produce offspring which resemble their parents on the

whole." But in spite of these statements we are to believe that if a plant or animal acquires a useful addition to or mortification of its structure during life, this is the particular variation which will *not* be transmitted. Since the modifications acquired by use during life are necessarily useful, it seems that according to the Post-Darwinians, the only way of acquiring useful variations known to us, is excluded from the process of Organic evolution. To say the least of it, the doctrine of probabilities is severely taxed by such a position as this.

But we say further, with Professor Cunningham, that were this hypothesis true, there should have been no evolution. If acquisition during life-time, is to render a character non transmissible, the continued growth of a single character by accretions during successive generations through geological ages could not and ought not to occur. Each generation should begin where its ancestors began in the matter of useful characters, or those acquired by use, so that there could be no accumulation or development of such characters. The influence of the environment, as well as that of the energies of the living being, would be incompetent to develop more in a given generation than that generation could acquire in its single life-time. How then can evolution account for the law so beautifully dis-displayed by paleontology, of the gradual modification of parts through long geological ages, towards given ideals of mechanical perfection? How can we account for the gradual perfecting of the articulations of the internal and external skeletons of forms which possess them? Not only is no explanation offered the Post-Darwinian school, but such progress is under their hypothesis, impossible. It is an explanation of *obscurus per obscurius*. But we are still of the opinion, in spite of Weissman's theory to the contrary, that so long as the germ plasma is subject to nutrition, it is subject to influences occurring during the adult life of an animal, and it would be an exception to all the other tissues were it not so.—*E. D. C.*

A graceful tribute to the memory of Priestly, was recently paid by the first Unitarian Church of Philadelphia. A tablet

surmounted by a bust was placed on the interior wall of the church, and services in honor of the philospher, in which several scientific men took part, were held at the time of the unveiling. Priestly was not only one of the fathers of modern chemistry; it was also as a philosopher and theologian, and as one of the founders of the first Unitarian Church of Philadelphia, that he was honored on this occasion. Though this act of appreciation has come too late for him to enjoy, it will encourage others to contribute their share to the progress of mankind.

RECENT LITERATURE.

LANG'S COMPARATIVE ANATOMY.[1]—This is the beginning of an entirely new edition of Schmidt's Comparative Anatomy, and so far as one may judge from a single part, it is to be ranked among the best of the recent text books. On every page there is a freshness both in treatment and illustration which is pleasing, while the text reads almost like a story. There is one noticeable feature in the work; it is logical in its arrangement. Thus we have as an introduction a couple of pages of an account of the cell followed by twenty on the Protozoa; next the student is introduced to the egg and spermatozoan, cell complexes and tissues, a few words concerning the Metazoa, and with this preparation we are lead to the Cœlenterates and thence to the higher forms. Several features, which though not exactly new, we do not recall in any text book, are introduced into the classification, and are usually to be regarded as improvements. Thus the division of the Cnidaria (—Cœlenterata *s. str*) into Hydozoa, Scyphozoa and Ctenophora and the limitation of the first two of these by the character of the œsophagus (ento, or ectodermal) is a valuable feature, though it disarranges our preexisting ideas and transfers the Craspedota from the Hydrozoa to the neighborhood of the sea anemones and corals. So too the separation of the Plathelmintha from the Vermes is *certainly* to be warranted on morphological grounds. The present part of the work considers only the Protozoa, Cœlenterata, Plathelmintha, and Vermes, but if

[1] Lehrbuch du vergleichenden Anatomie, von Dr. Arnold Lang. Erste abtheilung, June, 1888, pp. 290.

the succeeding parts treat the other groups as well, the whole will certainly prove a success.

BIRDS OF IOWA.—In the proceedings of the Davenport Academy Natural Sciences for 1888, there appears a catalogue of the birds of Iowa, with notes.[1] It is published only as a preliminary list and so escapes most of the criticism that might be offered, were it simply presented as a complete summary of extended observations.

Although it is offered only as *preliminary*, yet it is the most complete and reliable list that has so far appeared. It shows the authors to be familiar with the habits and habitats of all the common birds of the state and also that they have a good knowledge of many that are rare.

The authors enumerate 255 species as coming under their personal observation. Among this number are many species which have not been heretofore recorded as having been observed in Iowa, although from their known geographical distribution it was naturally supposed that they were to be found here. The maximum number of species *probably* found in the state including summer and winter visitors and Sea-birds migrating north by way of the Mississippi river,—is not much above 350.

Taking into account the fact that the collections and observations, upon which this list is based, were made chiefly in the vicinities of Charles City, Des Moines, and Iowa City, all situated in the interior of the state, and thus not affording a good opportunity for the study of many of the water birds, the work shows itself to be the result of much time and study.

For the reason just stated the list is most deficient in water birds. It is especially complete in Passerine species, when we consider the number of summer and winter, as well as Western visitors this order affords.

That the comparative completeness of the list may be readily seen the following list is appended. The first column gives the number of species which are probably to be found in the state as compiled from the known geographical distribution. The second column contains the number given in the catalogue of Messrs. Keyes and Williams.

Pygopodes	10	4
Longipennes	22	5
Steganopodes	7	2
Anseres	43	26

[1] A preliminary circulated catalogue of the birds of Iowa, by Charles R. Keyes and H. S. Williams M.D. Prof. Davenport Acad. Nat. Sci. Vol. V.

Herodiones	13	8
Paludicolæ	11	8
Limicolæ	37	21
Gallinæ	6	5
Columbæ	2	2
Raptores	34	25
Psittaci	1	1
Coccyges	3	3
Pici	10	7
Macrochires	4	4
Passeres	153	136

The work is especially valuable for the following things:
Dates of arrival and departure of summer residents.
Dates of arrival and time of stay of migratory birds breeding farther North.
Dates of arrival and departure of winter visitors.
Breeding season and nesting habits.

F. M. Fultz, Burlington, Ia.

RECENT BOOKS AND PAMPHLETS.

Bergens Museum.—Aarsberetning for 1887. Bergen 1888. From the Museum.

Campbell, John P.—Biology and its place in a liberal education. Athens, Ga. 1888. From the author.

Cornell University.—Agricultural Station, Bulletin III. From the Station.

Gage, S. H.—Microscopial Tube Length—Thickness of Cover-glass. —Form and size of the Blood Corpuscles of the Lamprey—Morphology of Muscular fibres in Minute Animals. Ext. The Microscope. 1887–8. From the Author.

Jenkins, O. P., and Everman, B. W.—Description of eighteen new species of fishes from the gulf of California. Ext. Proc. U. S. Nat. Mus. 1888· From the Authors.

Korschelt, Eugen.—Ueber die Geschlechtliche Fortpflanzung der Einzelligen und besonders der Infusorien—Ext. Kosmos 1886.—Funktion und Lage des Zellkerns bei den Pflanzen. Ext. Biol. Centralblatt viii. From the author.

Lewis, T. H.—Effigy Mounds in Northern Illinois. Ext. Science. 1888. From the Author.

McCulloch, Oscar C.—The Tribe of Ishmael, a study in social degradation. 1888. From the Author.

Minot, C. S.—Second Report on Experimental Psychology upon the diagram tests. Ext. Proc. Am. Socy. Psy. Research. 1888. From the Author.

Parker, G. H.—The eye of the Lobster. Ext. Proc. Am. Acad. 1888. From the Author.

Plateau, Felix—Rechérches Expérimentales sur la vision chez les Arthropodes; 4e partie. Bruxelles. 1888. From the Author.

Plateau, Felix—Rechérches Expérimentales sur la vision chez les Arthropodes Vme partie. Bruxelles. 1888. From the Author.

Rice, Wm. N.—Science-Teaching in the Schools. Ext. Am. Nat. 1888. From the Author.

Weismann und Ischikawa.—Weitere Untersuchungen zum Zahlengesetz der Richtungskörper. Ext. Zool. Jahrbuch. 1888. From the Authors.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.

THE STATE OF MICHOACAN.—Michoacan is one of the richest and most fertile of the states of Mexico, rich in woods, in mines, and in capacity of cultivation. Along with part of Guanajuato, it formed the ancient kingdom of Mechocean. Its extent is 55,693 sq. kilometres, its population about 800,000. The entire state is mountainous, and a considerable portion is occupied by lakes, among the principal of which is that of Patgcucero. The coast line is 163 kilometres long and contains the ports of SanTelmo, Bucerico and Marauta. Among the principal peaks of the state are Tarcitaro (3,860 m.), Patambon (3,750 m.), Quinceo (3,324), Tarimangacho (3,104), Zirate(3,340), and San Andres (3,282).

BOLIVIA.—According to an interesting article in the last issue of the Spanish Geographical Society, the area of Upper Peru, now known as Bolivia, is 2,115,329 kilometres, or rather more than four times that of Spain. Its population, according to a census taken in some departments, and calculations made in others, is only 1,182,270, a figure considerably below previous calculations. The engineer Minchi gives the altitude of La Paz as 3,641 m., that of Lake Titicaca at 3,824 m., and

that of the peak of the Illimani as 6,488 m. This height agrees well with the average given by other surveyors. Sorata is thirty or forty metres higher. Among other elevated peaks are Chachacomani (6,203), Hauina (6,184), Murudata, (5,120) Sunchulli (5,546), and Tres Cruces (5,504). All of these as well as Sorata and Illimani are in the department of La Paz. In that of Oraro are Sajama (6,546), Parinacocha (6,376), Pomerape (6,260), Azanagues (5,136) and Guanani (3,968). In Pobors are the peaks of Charague (5,603), Potosi (5,830), Nuevo Mando (5,949), Lipez (5,982), Taguegua (5,704), Guadalupe (5,754), Esmeraca (5,406), Tazna (5,105), and Ubina (5,203), and in Cochabamba that of Tunare (4,726). The most elevated inhabited places are: Tolapalca (4,290), Potosi (4,166), in its highest part, Catamarca (4,141), and Oruro (3,792). The great tableland between the two ranges of the Andes has an average elevation of 3,800 metres.

The mountainous part of Bolivia may be divided into four regions: (1.) that between the sea and the high plateau, poor in vegetation but rich in minerals and salts; (2.) the plateau itself, also poor in its flora, but rich in mines of every class; (3.) the region of the valleys formed by the lateral chains of the interior of Royal Andes, the chains which unite the two main ranges, and the buttresses of the interior range—this is a most fertile country with exuberant vegetation; and (4.) the eastern plains, a land of virgin woods and wilds.

Among the valleys of the third region may be mentioned those of Beni, Santa Cruz, and Cinti, the last famous for its wines. The *yungas* are deep valleys, whose temperature never descends below 21° and rises to 45 C.

In the E. and N. are the great flats of Beni, Santa Cruz, Chiquisaca, and Tarija. The river Beni and its tributaries inundate these flats in the flood season, leaving large lagoons, and giving rise to insalubrious conditions. More to the E. the Paraguay also inundates the flats of Manzo and Gran Chaco, forming the Tarayas lakes. Between the Paraguay and Pilcomayo are great salt lakes, the most notable of which is Izozo. Some sierras arise in the eastern part, on the confines of Brazil, the most easterly that of San Simon.

The greater part of the rivers of Bolivia are affluents of the Amazons or the La Plata, and are navigable. Only one river, the Loce, reaches the Pacific, all others are lost in the Atacama desert.

About a third of the population is white, the rest for the most part Indian or Mestizo. Among the higher classes of the

whites, French customs prevail, but the Chulos or Mestizos still wear the dresses they wore when they were Spanish subjects.

EUROPE.—GEOLOGICAL WORK IN SPAIN.—The two first volumes of the Commission of the Geological map of Spain treat of the geology and mineralogy of the province of Huelva, and will be followed by two other volumes treating of the petrography of the same province. The same Commmission has also published the fourteenth volume of its bulletin, which is almost exclusively occupied by a description of the lower cretaceous formation of, by Sr. L. Mallado, forming part of a Palæontological Synopsis of Spain, which commenced with the ninth issue of the same bulletin. The general geological map of Spain, consisting of thirteen sheets, is also almost complete. The Commission of Mining Statistics has also published a map of the peninsula showing the areas conceded in each province for the exploitation of various minerals. The Hydrographical Commission has not only published the plans of various parts of the Mediterranean coast, but is at work upon those of the Philippines.

ENGINEERING WORKS IN EUROPE.—Among engineering works of geographical importance now being carried on in Europe, are the canal across Schleswig from the North Sea to the Baltic, commenced in June, 1887, and likely to be finished next year; and the construction of a railway from Belgrade to Salonica. In Italy a project is on foot to convert Rome into a sea-port by forming a canal from the south-east part of the city to the coast. As the Tiber, at the highest point of the canal, is but twelve metres above the level of the sea, the project does not involve any very great difficulty.

A new port for the city of Bilboa is also projected. Belgium is commencing a series of fortifications upon the river Meuse to protect the territory in case of a new Franco-German war.

SARDINIA.—From the fourteenth to the sixteenth century, during the time that Sardinia belonged to Aragon, the official language of the island was that of Catalonia, but this was superseded by the Castilian tongue after the union of Aragon and Castile. Nevertheless the Catalan language is still spoken at the northern end of the island, where, at the foot of Nurra, the Catalan Sr. Toda, found himself perfectly

understood. In Alguer, an ancient walled city of 12000 inhabitants, the names of the streets are Catalan as are also the speech of the populace and the songs of the children. Since the Peace of Utrecht in 1720, the Castilian tongue has given way to the Italian, yet even within its capital, Cagliari, the Spanish tongue is still used in the nunnery of Santa Clara.

THE MOUNTAIN RANGES OF SPAIN.—The highest peaks of the Pyrenees, according to the recently issued, "*Reseña Geographica y Estadistica de España*, are Nethon, 3404 metres; Pico de Posets, or Landana, 3,367 m.; Maladetta or Montes Malditos, 3,354 m.; and Tres Sorores or Mont Perdu, 3,351 m.

The northern range of the Iberian peninsula is by D. J. Bisco considered as composed of two sections, the one east, the other west, of the northern end of the Iberian range, which is that which forms the western border of the Ebro valley, and which prolongs itself southward sufficiently to form a base from which rise the ranges running east and west between the various rivers of Castille and Andalucia. The highest peaks of the Vasco-Cantabrian or eastern portion of the northern cordillera are: Peña de Cerreda, 2678 m.; Peña Vieja, 2639 m.; Peña Prieta, 2520 m.; and Contes 2373. The two highest peaks of the western or Galicio–Asturian part of the northern range are: Espiguete 2453 m.; and Peña-Ubina, 2300. The Iberian, or north and south system, the highest portion of which is known as the Mountains of Burgos, has no peaks comparable to those of the Pyrenees, its three highest summits being Moncayo 2315 m,; San Lorenzo, 2303 m.; and the Picos de Ebibron, which rise to 2246 metres. The city of Burgos stands at a height of 856 metres.

The ranges which run westward from the Iberian are the Central, between the basins of the Duero and Tajo (Tagus); the Toledo Mountains, between the Tajo and the Guardiana, the Sierra Morena, and the Sierra Nevada. The highest summits of the Central system are: Plaza del Moro Almansor 2,650 metres; Calvitero 2.401 m.; Peñalara 2,400 m.; and Hierro 2,383. The city of Avila stands at a height of 1,126 metres, Segovia at 1,000, and the Observatory of Madrid is 655 metres above sea level. None of the Toledo Mountains attain great elevations, the loftiest being Corocho de Rocigalgo 1,448 metres and Vicente 1,429 m. Still more insignificant is the elevation of the Sierra Morena, which rising but slightly above the plains of Castile, may be regarded as little more than a huge step from those plains, to the valley of the

Guadalquiver. The highest points are, Estrella 1,299 m., and Rebollera 1,160 m.

South of the Guadalquiver, the Penibetic system culminating in the Sierra Nevada, though less continuous and extensive than the Pyrenees, attains in some points elevations second only to the Alps. The two loftiest peaks, Mulhacen 3,481 m., and Veleta 3,470 m., are both near Granada. Next in height come the Cerro de la Alcazaba 3,314 m., and the Cerro de la Caldera 3,289 metres.

AFRICA.—THE MUNI QUESTION.—According to a paper read by Sr. F. Coello, before the Geographical Society of Madrid, (Jan 9, 1889) the rights of Spain in the Gulf of Guinea date from a treaty made with Portugal in 1777, by which the island of Santa Catalina and the Spanish colony of Sacramento (in Brazil) were ceded to Portugal in exchange for the islands *Fernâo do Poo* and *Anno Bon*, together with the right to treat with the natives in all the neighboring coasts, from Cape *Formozo* at the mouth of the Niger, to Cape *Lopo Gonçalves*, or Lopez, S. of the *Gabâo*. (The Portuguese orthography is here given). Portugal had the right to dispose of these coasts, not only from having discovered them, but from having occupied the Cameroons, the Gaboon (where some relics of the Portuguese dominion have been found), and some points in the interior. In 1778 this treaty was ratified, and a Spanish expedition took possession of Fernando Po and Anno Bon. In 1827 the English occupied the former island, but afterwards surrendered it, and proposed to purchase it for 1,500,000 francs. This proposal was refused, and in 1843 an expedition took possession of both the above islands and of Corisco. The king of Corisco and of the Vengas tribes, who inhabit the neighboring coasts and the banks of the Muni, also acknowledged the sovereignity of Spain. No nation but France has disputed the rights of Spain upon the Muni, nor did France dispute them until many years later. In June, 1843, the French took possession of a blockhouse at the mouth of the Gaboon, the site of the present Libreville, but all annexations since made by France have been to the southward. Various treaties, letters of nationality, etc., have since bound the natives of various parts of this territory to Spain.

The first claim of France dates from May, 1860, and proceeded from the governor of the Gaboon. In 1883 the French openly claimed the territory, not only as far as the river Campo, (the northern boundary of the Spanish possessions)

but even to and beyond the Cameroons. The Germans, who later on commenced to treat with the natives of this part of the coast, recognized in 1885 the rights of Spain as far north as the river Campi. In various expeditions under Dr. Ossario, Ivadier, and the governor Sr. Montes de Oca, the basins of the Campo, Benoto or Eyo, and Muni, were explored, and as many as 370 chiefs recognized the rule of Spain. The territory thus embraced covers about 50,000 sq. kilometres, and if the strip is carried inwards between the same degrees of latitude to the Ubangi, parallel to the French possessions, would contain at least 180.000 k. It is, moreover, a fertile and thoroughly well-watered country, well-wooded and capable of great production.

THE CITY OF WAZAN.—It is extraordinary and almost unexampled, says Don T. de Cuevas, in a recent issue of the *Boletin of the Madrid Geographical Society*, to meet among the most remote folds of the Masamoda mountains a city of at least 11,500 inhabitants, a centre of mercantile activity and of traffic among semi-independent kabyles, the seat of a religious power that at the commencement of this century made the monarchs of the Magreb tremble on their throne, and the residence of Xarifes who descend from kings and even from a higher stock, since in their veins runs the blood of Mohammed. Uazzan has various orthographies, the French know it as Ouezzan, the English as Wazan.

When at the destruction of Baurce, 979-84 A.D. the Edrisite power was overthrown, part of the Edrisites took refuge in the Uad Droa, and established themselves in Axyen, a town of Arjona, at the beginning of the XVI. century, a little after the Xerifes Saadies had acquired the throne of Morocco. From Axyen, the emir Muley Abdallah changed his residence to Wazan. The consent of this Xerif is necessary in order to make the election of the Sultan legal.

GEOGRAPHICAL NOTES.—The Hungarian, M. Dechy has ascended Elbourz and has reconnoitred the glaciers which surround that peak; and M. Trillo has explored the right bank of the Volga and has discovered the ruins of an ancient city, in which, from the marbles, aqueducts, and Arab, Persian, and Tartar coins met with, a high civilization must have existed.

Two small sections of railway have at last been opened in Persia, one from Teheran to Xahzade-Abdulazin, the other from the coast of the Caspian to Amal, the capital of the

province of Mazanderan. A line uniting the Persian gulf and the Caspian sea is also spoken of.

The Germans accuse the English of delaying the rectification of the bounderies between the possessions of the two countries in the Niger region, until they had made sure of their claims over the Upper and Central Binue by means of treaties with the native chiefs. France and England dispute the protectorate of the Egba territory, situated to the north of Porto Novo and Lagos. The English claim that the natural route to Abeokuta, the Egba capital, is by the river Ogun, which disembogues at Lagos, while the French claim that it can be reached as readily by the French river Addopero. The truth is that the Frenchman M. Viard has got ahead of the English in treating with the Egba king.

The expenses of the Congo Free State during 1887, have amounted to 1,891,190 francs, spent in political and judicial administration, transport and mails, constructions, geographical explorations, etc. The receipts are not given, but they must be small, since at present ivory is the only article of commerce.

The treaty by which the Sultan of Zanzibar conceded the greater part of the coast of Zanguebar to Germany, came into force the 15th of August last, but the rebellion of the natives of Pangani has spread along the coast and makes German domination difficult. It is said that at the present time the Germans have abandoned the only two points they had occupied viz: Bagamoyo and Dar-es Salam.

Turkey has sought to reclaim the port of Zeila, in the gulf of Aden, asserting that it was yielded to Egypt on condition of an increased tribute; but England asserts that the said port is in the Egyptian dominion. In the meantime Zeila remains in the hands of England.

Among the boundary disputes which are common in America, there has now risen one which is also a question of money. Rich gold fields have apparently been discovered in Dutch Guiana, between the rivers Lava and Papanaom; but the French call to mind that both these rivers are affluents of the Marouine, which forms the boundary between the two colonies, and therefore doubt the right of the Dutch to the territory.

According to a provisional treaty concluded between Bolivia and the Argentine Republic, the boundary between the two countries follows the parellel of 22° S. from the Paraguay to the Pilcomayo, thus leaving the two coasts of the navigable part of the latter river in the possession of the last named country.

Last March the French took possession of the Society islands, it is said, at the invitation of the inhabitants, but some of the natives of the island Raiatea attacked a French detachment. England has taken possession of the Fanning islands, south of the Sandwich group. England has also acquired the island of Rarotonga, which is advantageously placed between Panama and Australia, and which France considered as a natural connection between Tahiti and New Caledonia.

Germany has declared the neighboring Tonga group, which England intended to take possession of, to be neutral in accordance with the agreement signed by both powers April 6, 1886.

GEOLOGY AND PALÆONTOLOGY.

CREDNER ON PALÆOHATTERIA. The seventh part of Dr. H. Credner's account of the Stegocephali and Saurians found in the "Plauens'ch Grounds," near Dresden, is devoted to the above-named interesting genus of Reptilia. A single species is embraced in the genus, *P. longicaudata* Credner. This animal was of about the size of the *Sphenodon punctatum* of New Zealand, and presents so many points of affinity, that Dr. Credner places it in the same order, the Rhynchocephalia, and even in the same family, the Sphenodontidæ.

An examination of Professor Credner's description and the figures with which it is abundantly illustrated, shows that its describer has not overrated the importance to biology of its discovery. But its nearest ally is not, as Professor Credner supposes, the *Sphenodon punctatum* of New Zealand, but the fossil *Stereosternum tumidum* from the probable carboniferous formation of Brazil. It differs widely from Sphenodon in the character of the pelvis, agreeing in this with Stereosternum, and with the Pelycosauria. It differs from the Pelycosauria in its two postorbital cranial arches, and in its single-headed ribs, agreeing in the latter point with both Stereosternum and Sphenodon; and probably in the former point also, but the character of the cranial arches in Stereosternum remains unknown. It agrees also with the Brazilian genus in the characters of the tarsus, and differs more from the Pelycosauria and less from the Sphenodon. The humerus is also like that of Stereosternum.

The conclusion is that Palæohatteria is one of the Proganosauria, and that it is probably a member of the family of the Stereosternidæ. The division Proganosauria differs from the Rhynchocephalia by the structure of the pelvis.

Since the above was written, a review of Professor Credner's paper, by Dr. G. Baur, appeared in the February number of the *Americau Journal of Science and Arts.* His conclusions are similar to those reached by myself.—E. D. COPE.

BROGNIART AND DÖDERLEIN ON XENACANTHINA. Thanks to these authors we are now well acquainted with the structure of this important type of palæozoic fish. M. Brogniart[1] has described the structure of the skeleton, and Professor Döderlein[2] gives us that of the skull. The former bases his observations on numerous specimens from Commentry, and the latter on material from the coal formation of Alsace. He shows that it is nearly allied to Didymodus from the North American Permian, and represents the same ancestral type of fishes. The cranial structure is that of an Opistharthrous shark; that of the lateral fins is of a Dipnoan type; while the characters of the median fins are those of a primitive Teleostome, as seen in some Crossopterygia. There is a well developed hyomandibular; and the toothed spine, long known as a separate body, and first identified by Kner, is articulated with the posterior median part of the cranium. The pectoral fin is unsymmetrically bipinnate, and the ventrals are unipinnate. They arise from a lateral cartilage, and terminate in a simple, elongate, fringed plate, which is the position of the male organ of the sharks. The vertebral centra are unossified, but intercentra and mesial spines are present, the former supporting short ribs. The dorsal fin is especially interesting, as displaying one of the primitive stages of development of this organ. It is distinguished by the enormous size of its basiosts, which, as in Lepidosiren, are articulated with the axinosts. The fin radii also articulate with the baseosts, thus differing from the Lepidosirenidæ, and agreeing with Pheneropleuron. And all these support with the neural spines, confirming the view which I have taken of the original relation of the fins to the vertebral column.

Dr. Döderlein agrees very nearly with the position assigned this division (the Ichthyotomi) by the present writer, except that he thinks that it should be separated from the Elasmo-

[1] Etudes sur le Terrain Houillier de Commentry, par C. Brogniart et E. Sauvage.

[2] Zoologischer Anzeiger, 1889, March 4th.

branchii and maintained as a distinct class like the Dipnoi. He employs Lütken's name, Xenacthini for it, but this must be clearly retained for the subdivision of the Ichthyotomi to which Xenacanthus properly belongs. If for instance, it should be discovered that Acanthodes belongs to the Ichthyotomi, (AMERICAN NATURALIST, 1887, p. 1016) the Xenacanthini and Acanthodini would be two of its primary divisions.

It is to be regretted that M. Brongniart was not better acquainted with the work done in America on this group, as he would have been thus spared the necessity of making some new names.—E. D. COPE.

CROLL ON MISCONCEPTIONS REGARDING THE EVIDENCE OF FORMER GLACIAL PERIODS. In a paper read before the Geological Society of London, January 23, 1889, Dr. James Croll made the following statement:—

The imperfection of the geological record is greater than is usually believed. Not only are the records of ancient glacial conditions imperfect, but this follows from the principles of geology. The evidence of glaciation is to be found chiefly on *land-surfaces*, and the ancient land-surfaces have not, as a rule, been preserved. Practically, the several formations consist of old sea-bottoms, formed out of material derived from the degradation of old land-surfaces. The exceptions are trifling, such as the underlayer of coal-seams and dirt-beds, like those of Portland. The transformation of an old land-surface into a sea-bottom will probably obliterate every trace of glaciation; even the stones would be deprived of their ice-markings; the preservation of boulder-clay, as such, would be exceptional. The absence of large, erratic blocks, in the stratified beds, may indicate a period of extreme glaciation, or one absolutely free from ice. The more complete the glaciation the less probability of the ice-sheet containing any blocks, since the rocks would be covered up. Because there are no large boulders in the strata of Greenland or Spitzbergen, Nordenskiold maintains that there were no glacial conditions there down to the termination of the Miocene period. The author maintained that glaciation is the normal condition of polar regions, and if these at any time were free from ice, it could only arise from exceptional circumstances, such as a peculiar distribution of land and water. It was extremely improbable that such a state of things could have prevailed during the whole of the long period from the Silurian to the close of the Tertiary.

A million years hence, it would be difficult to find any trace

of what we now call the glacial epoch; though if the stratified rocks of the earth's crust consisted of old land-surfaces, instead of old sea-bottoms, traces of many glacial periods might be detected. The present land-surface will be entirely destroyed, in order to form the future sea-bottom. It is only those objects which lie in existing sea-bottoms which will remain as monuments of the post-tertiary glacial epoch. It is then probable that the geologist of the future will find in the rocks formed out of the non-existing sea-bottom more evidence of a glacial epoch during post-tertiary times than we now do of one, say, during the Miocene, Eocene, or Permian period. Palæntology can afford but little reliable information as to the existence of former glacial periods.

THE VERTEBRATA OF THE SWIFT CURRENT RIVER, II. In the NATURALIST for 1885, p. 163, the writer gave a brief account of the vertebrata of the above locality obtained by the Geological Survey of the Dominion of Canada. Explorations set on foot by the Director of the Survey, Dr. A. R. C. Selwyn, during the year 1888, resulted in the obtaining of a number of additional species, some of which are of considerable interest. In describing these, I will enumerate those already known from that locality. The specimens are generally in a fragmentary condition, owing to the conglomeritic nature of the deposit. The new material was obtained by Mr. T. C. Weston, of the Survey. The total number of species is seventeen.

PISCES.

Amia sp., numerous vertebræ.

REPTILIA.

Trionyx sp., Ann. Report, G. N. H. Survey, Canada, 1885, c. p., 79.
Stylemys sp. loc. cit.

MAMMALIA.

Rodentia.

Palæolagus turgidus Cope, loc. cit.

Bunotheria.

Hemiopsaldon grandis Cope, loc. cit., and American Naturalist, 1885, p. 163.

Ancylopoda.

Chalicotherium bilobatum sp. nov.

Founded on a mandibular symphysis and part of the left ramus of an adult animal, which contains the alveoli of the anterior four molars, and part of that of the fifth. All the premolars are two-rooted, showing that they are but three in number. Canines and incisors wanting, the anterior alveolar margin thin and little prominent, and bilobed, with a median emargination. Symphysis coössified, with an angulate inferior margin, posteriorly with a fossa on each side of the median line, sloping regularly upwards to the alveolar margin, and concave above behind the margin. Minute traces of alveoli of a canine and two incisors on each side, which were probably present in the fœtus. Length of symphysis above, 120 mm.; depth posteriorly, 48 mm. Length of symphysis in front of p. m. iii. Length of premolar series, 75 mm. Length of m. i., 40 mm.

Although this is the first announcement of the discovery of the genus Chalicotherium in America, it is not the first discovery. Professor Scott showed me a series of superior molars from the Loup Fork formation of Kansas, from the Agassiz Museum, which he identified as belonging to this genus. The present species is of larger size than the Kansas form, and is apparently equal to the *C. goldfussii* of the Upper Miocene of Europe. The occurrence of this form in the Lower Miocene (White River), as well as the Upper Miocene (Loup Fork), of this country, is a noteworthy fact, but is parallel to its history in Europe. Described from the upper Miocene by Kaup, it was afterwards found in the middle Miocene (*C. grande*) by Lartet, and in the Upper Eocene (*C. modicum*), by Gaudry.

The remarkable character of this genus, as discovered by Filhol, has been already mentioned in the NATURALIST.[1] It has little relation to the family of Perissodactyla, to which it has given the name, and which it so resembles in molar dentition. It must form a family by itself, and the genera with which it has been associated must form a family to which the name Lambdotheriidæ may be applied. The anterior ungual phalanges of Chalicotherium are of prehensile character and not ungulate, but rather unguiculate. The phalanges resemble those of the Edentata, but the carpus and tarsus are, according to Filhol, diplarthrous in structure, while the Edentata are taxeopodous. We have in the Chalicotheriidæ the antithesis of the Condylarthra. While the latter is ungulate with an unguiculate carpus and tarsus, the former is unguiculate with an ungulate (diplarthrous) carpus and tarsus. Thus

[1] Osborn on Chalicotherium, 1888, p. 728.

the Chalicotheriidæ must be referred to a distinct order of unguiculate Mammalia, which I propose to call the Ancylopoda, with the above definition. Two genera belong to the single family, the Chalicotheriidæ; viz., Chalicotherium Kaup, and Ancylotherium Gaudry. In the former, the phalanges are distinct; in the latter the first and second are coössified (Lydekker). Marsh has not yet shown how his genus Moropus differs from Ancylotherium. The species described by Marsh under this name are from the Loup Fork bed of Kansas.

Perissodactyla.

Haplacodon augustigenis, Cope, gen. nov. *Menodus angustigenis*, Cope, Annual Report, G. N. H. Survey, Canada, 1885. C, p. 81.

Char. gen. Additional specimens of the species described, as above cited, show that it cannot be referred to the genus Menodus, but that it belongs to the family Lambdotheriidæ (Chalicotheriidæ *olim*) as at present defined. It differs from all the genera of the Menodontidæ in the presence of but a single internal cusp of the first (posterior) superior premolar, a fact which renders it highly probable that the premolars which precede it in the maxillary bone, were similarly constituted. It differs from all other genera of Lambdotheriidæ and also from Diplacodon, to which it is allied, in the presence of but two inferior incisors on each side. It is not certain whether it possesses horns or not.

Menodus sp. Cope, Ann. Report, l. c. p. 83.

This species is allied to the *M. giganteus* Leidy, but whether identical or not can not be yet ascertained.

Anchitherium westoni sp. nov.

This species is represented by a single superior molar, and two inferior molars, the latter in place in a part of the mandible. The teeth are smaller than those of the *A. bairdii*, from which they also differ in their greater transverse as compared with their anteroposterior diameters. The intermediate tubercle of the posterior crosscrest is more distinct than that of the anterior, and the posterior intermediate cingular cusp, so prominent in the *A. bairdii*, is here wanting. The posterior cingulum continues round the internal base of the posterior internal cusp. Diameters of superior molar; transverse, 13.5 mm.; anteroposterior, 10 mm. Diameters of inferior molar; transverse, 8 mm.; anteroposterior, 10.5 mm. This species, interesting for its primitive character in the absence of the

posterior cingular cusp, is dedicated to Mr. T. C. Weston, the explorer of the region from which these fossils were obtained.

Aceratherium mite Cope, l. c.

Aceratherium pumilum Cope, l. c.

Artiodactyla.

Hypertragulus transversus sp. nov.

Indicated by two superior molar teeth of old individuals. They are of nearly twice the linear dimensions of the only known species, *H. calcaratus* Cope. The external cusps are subconical, and the external rib which separates them in Leptomeryx is wanting here. Anterior cingular cusp small. The anterior bone of the posterior internal crescent enters the notch between the external cusps but does not fuse with either of them. Slight cingula on the anterior and posterior sides of the internal lobes which do not pass round their internal sides. No external cingulum. Diameters, anteroposterior, 12 mm.; transverse (at base) 15 mm. Crown very brachyodont.

Leptomeryx esulcatus sp. nov.

A single superior molar indicates this species, which is of about the dimensions of the *L. evansii*. It differs distinctly from this Tragulid, in the greater convexity of the external face of the external cusps, and the absence of the sulci which define an external median rib of that surface in the *L. evansii*. The rib which bounds the external faces of the cusps from each other is present. Anterior external cingular cusp small, continuous with anterior cingulum. No internal nor external cingulum. Diameters of crown; anteroposterior, 6.5 mm., transverse, 7.5 mm.

Leptomeryx mammifer Cope, Report, G. N. H. Survey, Canada, 1885, C p. 84.

Four superior molars add to the characters already derived from mandibular teeth as above cited. The median and anterior external cingular cusps are large and obtusely subconical. The anterior external cusp has a very strong median external rib, while the posterior has a very weak one. The anterior horns of the internal crescents are much produced; the posterior but little. The cingula are slight, and are not continued round the internal base. Diameters of superior molar; anteroposterior, 11 mm.; transverse, 11.5 mm.

Leptomeryx semicinctus sp. nov.

A large species possessing twice the linear dimensions of the *L. evansii* in the superior molar teeth, is represented by three

of the teeth designated. In these the external crescents are more compressed and less conical than the two species above described, resembling more nearly those of the *L. evansii.* The posterior has a weak vertical rib; the anterior a strong one. The external cingular cusps are thoroughly fused with the external crescents, forming their anterior horns. The anterior horns of the internal crescents are a little more produced than the posterior. No external or posterior cingulum; a much interrupted anterior cingulum, which is continued round the internal base of the anterior crescent, which is further continued on the anterior side of the internal base of the posterior crescent. Enamel finely wrinkled. Diameters; anteroposterior 14 mm.; transverse, at base, 15 mm.

Oreodontidæ, an inferior first premolar.

Elotherium mortoni Leidy; l. c.

Remarks.

The continued scarcity of Oreodontidæ is matter of surprise. Their place is supplied so far, by an increased number of Tragulidæ (four species). The presence of a genus of Lambdotheriidæ, Haplacodon, increases the impression of antiquity of the fauna produced by the presence of a Creodont (Hemipsalodon.)

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Interbedded with the Tertiary schists of the western Cordilleras in Peru and Bolivia, are andesites, which are divided by Rudolph[2] into a western area of pyroxene-andesites, an eastern area of horn blende-andesites and a middle area of a variety intermediate between these two. The structure of each class varies from those types in which there is a devitrified glassy groundmass, to those in which the groundmass is microcrystalline. The plagioclase is andesin that has suffered alteration in the center because of the more basic character of this portion. The pyroxene-andesites contain augite twinned parallel to $P\bar{\infty}$, and also an orthorombic pyroxene with a cleavage parallel to $\infty P\breve{\infty}$ and a parting parallel to OP. Both augites have in some cases undergone alteration into bastite. By an increase in the amount of hornblende the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Miner. u. Petrog. Mitth. ix. p. 269.

pyroxene variety passes over into the typical hornblende-andesite through stages in which hornblende and pyroxene are both present, the amount of the one increasing with diminution in the amount of the other. The hornblende is often surrounded by an opacitic rim in which are frequently numerous little crystals of augite. Tridymite is both an original and a secondary constituent in all varieties of the andesites, with the exception of the dacites in the extreme eastern portion of the area studied, where the silica is in the form of opal and porphyritic quartzes. The biotite present in many specimens contains apatite and rutile inclusions regularly arranged, the former with their long axes perpendicular and parallel to the *c* axis of the mica, and the latter cutting each other at angles of 60°. The author describes the course of a silicification process which has taken place in some of the rocks, and also the eutaxitic structure noted in many of them.—Of the Andes mountains in Colombia four distinct ranges are recognized, viz: the Western, Central, Eastern and Coast Cordilleras. The structure and the rocks of the Central and Eastern ranges have recently been studied by Hettner and Linck.[1] In the former granite, gneiss, crystalline schists, diabase, dacites, andesites and clay slates occur. The crystalline schists and the slates are regarded as Archaean. In the Eastern range none of the younger rocks were found, except a tuff composed of andesite material. Among the older rocks found in this area may be mentioned a quartzite and a felsophyre.—In a beautifully illustrated paper on the rocks between the Province of Minas Garaes and São Paulo, in Brazil, Machado[2] describes the gneisses and the sedimentary rocks of the region, nepheline-syenite, quartz-augite-diorite and olivine-diabase. The last mentioned rock occurs in dykeform and presents no unusual features. The diorite forms a stock in the gneiss. It contains in addition to its essential constituents also hypersthene and scapolite. The most interesting portion of the paper is that devoted to the nepheline-syenites. These are pre-Devonian and form the plateau of Poços de Caldas. Three types are distinguished —a coarsely granular, a fine grained and a dense and porphyritic type. They all contain the same components, viz: orthoclase, nepheline, aegerine, biotite, sodalite and cancrinite (as a decomposition product of nepheline), and grade over into one another. Wollastonite, lovenite and epidote also occur in some specimens as accessory constituents. Darker fine

[1] Zeits. d. deutsch. geol. Gesell. XL. 1888. p. 205.

[2] Miner. n. Perog. Mitth. IX. p. 318.

grained varieties of the rock often appear as if included in lighter colored coarser grained kinds, the color of the two rocks depending upon the percentages of augite in them. The dense varietiesoften show a fluidal structure in the arrangement of little microlites of augite, and sometimes possess these in dendritic groups. Rutile is noted as an alteration product of sphene, and several unknown minerals are briefly described.—In an English summary at the end of his book[1] Reusch gives a description of the remarkable geological region of Norway where eruptive, sedimentary, vein and dyke rocks have had developed in them by the action of great pressure, a schistisity which was attended by chemical change in the original constituents of he rock masses. Through processes carefully described the author shows that granite may originate from clastic rocks and afterwards be intruded as an eruptive into other eruptive and clastic rocks in the form of dykes. Gneiss veins are said to be common in the region, and schistose gabbro, diabases and other basic rocks occur in great quantity. The book contains three colored maps and two hundred-and-five wood-cuts of geological sections and sketches of thin section of rocks. From his observations, Reusch draws some important conclusions which will probably explain many of the difficulties met with in solving the problems of the origin of crystalline schists.—A hornblende-peridotite[2] from a hill at the south foot of Kilimandjaro in E. Africa is an allotriomorphic granular aggregate of grass-green hornblende, salmon colored hypersthene and colorless olivine. The hornblende and olivine include rows of opaque rod-like bodies. The hypersthene is pleochroic as follows: a=salmon-red; b = pale yellow; c = sea-green. Pleonast and magnetite are among the other constituents.—A few small isolated patches of a green rock occurring just north of Aberdaron in North Wales, and colored as serpentine on the survey maps of Wales are regarded by Elsden[3] as serpentinized diabases. Unaltered diabases, hornblende-gabbros, and porphyrites from the same region are also briefly described by the author.—Mr, Wethered[4] has discovered well outlined quartz crystals in the insoluble residues of the Carboniferous limestones at Clifton, England, that have resulted by the enlargement of fragmental quartz grains by the deposition of silica derived from organic sources.—In the

[1] Bommeloen og Karmoen med. omgivelser geologisk beskrevne. Kristiania. 1888.
[2] Hatch: Geol. Magazine, May, 1888. p. 257.
[3] Geol. Magazine, 1888. p. 303
[4] Quart. Jour. Geol. Soc. May, 1888. p. 186.

course of a paper on the Huronian rocks from Sudbury, Canada, Bonney[1] describes altered feldspar fragments in a conglomerate, that have given rise to flakes of mica and interlocking grains of quartz. He points out that the same change on a larger scale might produce a gneiss—a result which has already been indicated by Van Hise.[2]—A rock composed entirely of a mosaic of hornblende and biotite is mentioned by Horton[3] as having been collected at Dosky Sound, New Zealand.—Jade has been found by Von Fellenberg[4] on the contact between limestone and serpentine on the Pizzo Lunghino, near the Maloja Pass in the Alps.

MINERALOGICAL NEWS.—In a Bulletin of the New York State Museum[5] F. L. Nason describes some fine crystals of brown *tourmaline* from Newcomb, Essex Co., N. Y. of *pyroxene* from Ticonderoga in the same county, and of some *calcites* collected by the late Prof. E. Emmons at Rossie, St. Lawrence Co. The brown *tourmalines* occur in Laurentian limestone, and present in general the features of the well-known Gouverneur mineral. They are associated with graphite, apatite, sphene, wernerite, quartz, zircon, muscovite, albite, tremolite, pyroxene and pyrite. Some of the crystals are of large size and others are so flawless as to have yielded fine gem material. A characteristic grouping is that in which a number of parallel growths are terminated at one end by a form common to the entire group, while at the other end each individual has an independent termination. Some of the *sphenes* exhale a feted odor when struck, and many of them include rutile needles with a distinct crystalline form. *Dipyr* crystals of large size are glassy or transparent and enclose crystals of sphene and opaque acicular inclusions arranged with their long axis parallel to the *c* axis of the dipyr. The *calcite* crystals from Rossie are remarkable for the fact that they are all twins. The most common twinning plane is °P. Twins parallel to ∞ P are also quite frequent. Often trillings occur in which two of the crystals are twinned according to one law, and are twinned with reference to the third crystal in accordance with the second law. One set of rhombohedral faces is smooth and glistening while the second set is rough. The pyroxenes are from a vein

[1] ib. Feb. 1888. p. 32.
[2] Amer. Jour. Sci. xxxi. p. 453. AMERICAN NATURALIST, Aug. 1886. p. 723.
[3] Quart. Jour. Geol. Soc. Nov. 1888. p. 745.
[4] Neues Jahrbk für. Min., etc., 1889. I. p. 103.
[5] No. 4. Aug. 1888. Albany.

of calcite in gneiss, which vein has been worked for graphite. These pyroxenes are sometimes eighteen inches in length and thirty-six inches in circumference, and exhibit a parting parallel to oP. The pyroxenes are thought to be older than the calcite but younger than the quartz with which they are associated.—Interesting parallel growths of ***andalusite*** and ***sillimanite*** are described and figured by Lacroix[1] from Ceylon and from a metamorphic rock from Morlaix, Finistère, France. In the former instance the two minerals are intergrown with their *c* axes parallel, and in addition two other series of sillimanite crystals cross the principal one at angles of 90° and 45°. The same author finds that ***bamlite***, ***monrolite***, ***bucholzite***, ***xenolite*** and ***wörthite*** are either merely peculiar forms of sillimanite or impure varieties of this mineral.—Two ***barium feldspars*** from the manganese mines of Söjgrufran, Grythyttan, Sweden have been analyzed by Igleström.[2] The first is a red mineral and the second is white and transparent. Both are insoluble in acids. Their analyses yielded:

	SiO_2	Al_2O_3	FeO	MnO	BaO	MgO	CaO	Na_2O	K_2O
Red feldspar	61.90	15.80	5.00		9.58	1.30	.40	6.02	
White feldspar	54.15	29.60			1.26	1.52	1.00	12.47	

According to Des Cloizeaux the white mineral has the optical properties of albite.—The same mineralogist records the analysis of a clear straw yellow ***pyrrhoarsenite***[3] from the same mine. Its composition corresponds to the formula 10 (Ca. Mg. Mn.)$_3$ $(AsO_4)_2$ + Ca_3 Sb_2O_7, and is:

AO_2O_5	Sb_2O_5	CaO	Mno	MgO
53.23	6.54	20.21	10.82	9.20

Gonnard[4] mentions the rare mineral ***torbernite*** as occurring in quartz veins cutting granite in the neighborhood of Charbonnières les Varennes, Puy-de-Dôme, France. Here are found also fine pseudomorphs of quartz after calcite, the formation of which is explained as having taken place in three stages. 1), by the coating of the calcite crystals by silica; 2), by solution of the calcite, and 3), the filling of the molds left with silicious material mixed with a little clay. Druses of smoky quartz crystals found in the same veins are thought to owe their color to bituminous matter which floated on the surface of the siliceous waters that yielded the quartz and colored those last formed (the druse crystals).

[1] Bull d. l. Soc. Franç. d. Min. 1888. XI. p. 150.
[2] Ib. XI. p. 26.
[3] Neues Jahrb. f. Min., etc. 1889. I. p. 48.
[4] Bul. d. l. Soc. Franç. d. Min. 1888. xi. p. 265.

Rare Minerals.—The interesting zeolite ***beaumontite*** which has heretofore been known only at Baltimore has lately been discovered by Schmidt[1] in the vacuoles of a pitchstone from Sweden (Mien See.) The mineral has the same habit as the Baltimore crystals. Its double refraction is weak and its optical angle large. The plane of its optical axes is normal to $\infty P\grave{\infty}$ and parallel to the edge which this plane makes with oP. Schmidt can see no reason for regarding the mineral as anything more than a variety of heulandite.—Mr. Hanks[2] has given us an account of the occurrence of the rare mineral ***Hanksite*** from the vicinity of Borax Lake, San Bernardino Co., Cal. The best crystals have been obtained from a stratum of clay and sand underlying a two foot thick surface-layer of salt and thenardite, and from a second stratum of the same materials at seventy feet below the surface. These crystals are bounded by the planes oP, ∞ P, P, and 2P. When the basal plane is largely developed the crystals become hexagonal plates or columns. They vary in size from half an inch or less to three inches in diameter. Hanksite is known to occur also in the borax fields of Death Valley, Inyo Co., Cal., and at several localities in Nevada.—Recent investigations on the ***bertrandite*** from a pegmatite vein at Pisek, Bohemia, yield Scharizer[3] results differing slightly from those of Bertrand and Des Cloizeaux, who thought the mineral orthorhombic. Scharizer's measurements show it to be monoclinic with $B=90° 28' 34''$ and $a: b: c=1.7793: 1: 1.07505$.

New Books.—In the "First Report of Progress of the Geological and Mineralogical Survey of Texas,"[4] State Geologist Dumble gives a resumè of the rocks and minerals of economic importance existing within the boundaries of the State. Natural gas, petroleum, salt and coal are known to occur in large quantity within the boundaries of Texas, but the limits of the formations containing them have not yet been carefully mapped.—"A Course of Mineralogy for Young People,"[5] is a little pamphlet of sixteen pages which accompanies a collection of twenty-five common minerals. It is intended to aid young people in the determination of the most common minerals by teaching them to observe for themselves their most prominent characteristics. The

[1] Zeits. f. Kryst. xv. p. 573.
[2] Amer. Jour. Sci. 1889. Jan. p. 63.
[3] Zeits. f. Kryst. xiv. p. 17.
[4] Austin. State Printing Office. 1889.
[5] By G. Guttenberg, Erie, Pa.

book and the collection comprise the first portion of a course in mineralogy which has been arranged for the use of the Agassiz associations throughout the country. The price of the pamphlet and the twenty-five minerals which it describes is one dollar.—The principal formal and optical characteristics of the more important rock-forming minerals have been arranged by Rosenbusch[1] in sets of tables covering about twenty-five pages. The tables are of great convenience to students who are far enough advanced in the study of petrography to understand the significance of the terms used in them.

BOTANY.[2]

NOTES ON NEBRASKA LICHENS.—Our knowledge of the Lichen Flora of Nebraska is as yet very meager being confined principally to the work of Hayden and Hall during the Government Geological Surveys. Our knowledge, such as it is however, shows that our Lichen Flora has many interesting as well as instructive characteristics. There is a general dearth of the large eastern forms throughout the greater part of the state. There are, however, along the Missouri river and its tributaries, many forms that are found in the eastern states. The Flora of this region serves as a connecting link between the timber forms of the East and the prairie forms of the West. The prairie region has an abundance of earth forms such as Endocarpon, and many Buellias and Biatoras.

Many semi-mountain and mountain forms occur in the western and northwestern parts of the state. Beginning with the eastern border of the state and going west a gradual transition from timber forms to earth forms, is observable; and from these to the forms usually found in higher altitudes as Umbilicaria, Omphalaria, and similar forms.—*T. A. Williams.*

AS TO THE CITATION OF AUTHORITIES.—That the effects of individual eccentricity when given room for free development are always striking, is well shown by the diversity of methods used by botanists in giving authorities for scientific names. In the good old days when but one name, that of the author of the combination, was cited, there was, at least, uniformity and hence some certainty. But the later method

[1] Hülfstabellen zur Mikroskopischen Mineralbestimmung in Gesteinen. Stuttgart. 1888.

[2] This department edited by Dr. C. E. Bessey, Lincoln, Neb.

of citing the author of the specific name and especially the introduction of the parenthesis has resulted in a confusion which is certainly "enough to throw a strong man into blue convulsions." The advantage of the old method is its simplicity. The common objection to it is that it does not give any credit to the author of the specific name. But credit and glory are not the objects in citing authorities; surely it is not the only office of the parenthesis to serve as a sarcophagus in preserving the names of botanists who might otherwise be forgotten. The true purpose is accuracy in determining the species meant. Plants are continually being described under names already occupied, and unless the name of the author is given it is impossible to know what species is meant. Now if one of two plants bearing the same name is put in another genus how, unless the authority is cited, is one to know whether it is a new species or one of the original two, and if so which? On this account it is a great convenience to have the name of the author of the specific name given also. There are several ways of doing this. Some cite the author of the specific name even after the genus has been changed, as if he were the author of the combination, *e. g.* "Hypoxylon colliculosum Schw"—Rav. Fung. Am. No. 742. (for H. colliculosum (Schw.) Nits.) No worse method could be thought of. According to this Sphæria colliculosa Schw and Hypoxylon colliculosum Schw" are evidently two distinct things and some investigation is of course necessary to establish their unity. Schweinitz did not make the combination Hypoxylon colliculosum, and to cite him for it is confusing and absurd. A slightly better method is to give the name of the author of the specific name in a parenthesis omiting that of the author of the combination, *e. g.* "Puccinia phragmitis (Schum.) Winter Pilze 179. This should be P. phragmitis (Schum.) Körnicke. But many, misled by the omission of a name after the parenthesis, have written P. phragmitis (Schum.) Wint., and then P. phragmitis Wint. while on the other hand we find P. phragmitis Körn. In a large genus of intricate synonymy like Puccinia how is one without investigation to know that all these are the same? Another very peculiar method has recently broken out which it is to be hoped will not get abroad; that is, to put the name of the author of the combination in a parenthesis after that of the author of the specific name thus: "Hicoria alba L. (Britt.). Bull. of Washb. Coll. Vol. II, No. 9. This of course if it gains any foothold will give rise to all manner of false citations.

There are only two methods which can be used without making endless trouble and confusion. If but one authority is to be cited, give the author of the combination. Consider accuracy and convenience rather than glory and justice so-

called. If two are to be given, place the name of the author of the specific name in a parenthesis, and that of the author of the combination following, and outside. If, in this case, it seem strange to cite a botanist as an authority for a name he did not know, still it is in many cases the best way. For example, in the case of Lactarius plumbeus Fr.; if this is written L. plumbeus (Bull.) Fr., one knows that it is Agaricus plumbeus Bull. not A. plumbeus Schaeff, nor Mycena plumbea Fr. Again, Uropyxis petalostemonis De Ton. scarcely seems familiar. But any one can recognize in U. petalostemonis (Farl.) D. Ton., Puccinia petalostemonis Farlow. It may also be objected to this method, that in many cases it merely perpetuates worn out synonymy. But it is the only one which causes no confusion and indicates exactly the species meant. —*Roscoe Pound.*

A QUESTION REGARDING THE APPLICATION OF THE LAW OF PRIORITY.—The strict application of the law of priority to botanical nomenclature, raises several interesting questions. One of them is whether a specific name of the same etymology and meaning with its generic name should be retained. There seems no good reason why it should not, as long as they are not identical. Indeed botanists are doing this in the names of many Phanerogams, *e. g.* Echinocystis echinata (Muhl) and Larix laricina (D. R.). The author of these combinations gives Specularia speculum D. C., as a precedent, and Arctostaphylos uva ursi (L) is almost another. Among the Fungi there is Fomes fomentarius. There are two Fungi which offer excellent opportunities for doing the same, namely; Ramularia didyma Ung. and Cylindrium septatum Bon. Saccardo gives these as Didymaria ungeri corda and Septocylindrium bonordenii Sacc. But strictly according to the law of priority they should be Didymaria didyma (Ung.) and Septocylindrium septatum (Bon.) However strange these combinations appear, it would seem better as the great majority of specific names are arbitrary and without particular application, to apply the law of priority uniformly, than to make an exception for so slight a cause.—*Roscoe Pound.*

OF GENERIC AND SPECIFIC NAMES TOO NEARLY ALIKE. —Saccardo (in a note in Syl. Fung. V. p. 474) in commenting upon Winter's change of Cercospora pulvinulata Sacc. & Wint. to C. missouriensis Wint. on account of C. pulvinulus C. & E. reproaches him with admitting Nitzchia and Nitschkia. Saccardo changes the latter to Cœlosphæria on account of

its similarity to the former—a genus of Algæ. This led me to investigate some of the names which Saccardo himself admits. He allows without hesitation Libertella Desm. and Libertiella Speg and Roum ; Licea Schrad., and Lisea Sacc. ; Dichaena Fr. and Dichlaena D. and M. : Pleospora Rabh. and Phleospora Wallr. ; Entoloma Fr. and Entyloma D. B. ; Riessia Fres. and Reessia Fisch. and Eriosphaera Reich. and Eriosphæria Sacc. Whether or not these are too nearly alike depends upon the taste and pronunciation of those who use them. To one using the English pronunciation, Licea and Lisea are indistinguishable. Besides these he admits many which are very much alike, but more defensible, as Arthrobotryum and Arthrobotrys, Urospora and Urosporium. He retains Antennaria Lk. in spite of Antennaria Gærtn., and even gives under the genus Marasmius the sections Collybia and Mycena, although there are the genera Collybia and Mycena in the same family.

As regards specific names : he necessarily admits many which are very similar as pulvinula and pulvinulata, flavus and flavidus, etc. In a large genus, new specific names are rather hard to get and one ought not to be too sensitive. But are not the following too nearly alike : Puccinia penstem onum, Lev. and P. pentstemonis Pk ; P. schileana Speg. and P. scheliana Thuem; P. scleroteoides Mont. and P. sclerotioidea Cooke ? The following in Vols. III. and IV. are certainly indefensible : Phoma pini C. and Hark. and P. pini Sacc.; Phyllosticta viticola Thuem and P. viticola Sacc. and Speg. Zygodesmus ochraceus Corda and Z. ochraceus Sacc., Cladotrichum fuscum Poeuss and C. fuscum (Grev) Sacc.; Cercospora fumosa Pewz. and C. fumosa Speg. These and some others in the two volumes mentioned have been corrected, but in such out of the way places that very few would notice them. Those in Vol. III. are corrected in a note at the close of the index ; those in Vol IV. in a similar note mixed in with corrections of typographical errors. For this reason I have given them. The following from Vols. V. and VI. have not, as far as I can find, been corrected : Polystictus stereoides Fr., and P. stereoides Berk., Fomes calignosus Ces., and F. calignosus Berk., Clavaria cervina B. & C., and C. cervina Sm., Polystictus cinerescens Schw. and P. cinerescens Lev., Stereum concolor Jungh., and S. concolor Berk., Clavaria coronata Schw. and C. coronata Zipp., Cyphella ravenelii B. & C. and C. ravenelii Sacc. This last he substitutes for C. fulva B. & C. to avoid C. fulva B. and Br. But the worst of all is in the genus Polyporus where there is, No. 303, Polyporus armeniacus Berk. Engl. Flor. V. 147. and also No. 215, P. armeniacus Berk. Hook. Journ. 197.—*Roscoe Pound.*

SOME EXPERIMENT STATION BOTANY.—A dozen or so of the bulletins issued by the Agricultural Experiment Stations contain matter more or less botanical in nature. From these the following notes have been rather summarily made.

In Dakota the growth of planted trees during the two years 1886 and 7 was watched and noted.—In Missouri forty "varieties" of grasses were grown and their deportment noted under certain local conditions.—In Kansas the observations upon grasses and clovers extending through fourteen years have been summarized and recorded in Bulletin No.2.—In Florida, the grasses have been grown and watched in like manner.—In Indiana, Professor J. C. Arthur (in Bulletin 15) describes popularly, but accurately, the structure of the potato tuber. The treatment of the subject is admirable and aside from its horticultural value the paper is of value and interest to botanists.—In Minnesota the Bulletin for July, contained a popular account of the organs of fertilization in plants with especial reference to the artificial pollination of cultivated plants.—The August bulletin of the Iowa station contained an interesting paper on corn tassels and silks, and a popular discussion of grasses and other forage plants. Mr. Crozier's notes upon the wild grasses of Northwestern Iowa are valuable, although some of the English names used by him are misleading and confusing. "Blue Stem" for *Agropyrum glaucum* and "Buffalo Grass" for *Bouteloua oligostachya* ought not to be tolerated.—In Texas, Bulletin 3 is devoted to popular notes on native and introduced grasses and other forage plants.—Bulletin 4, of the Minnesota station, devotes sixteen pages to "Fungi which kill insects," by Otto Lugger. The paper is a well written summary derived from various sources, with observations by Mr. Lugger, and is illustrated by nine cuts two of which are original.—The November bulletin, from the Iowa station, includes a short paper by C. P. Gillette on Chinch-bug Diseases (*Empusa* sp. and *Micrococcus insectorum*) and "Some Injurious Fungi" by Mr. Crozier. The latter are Apple Blight, (*Micrococcus amylovorus* Burrill.) Potato Rot (*Phytophthora infestans* DeBary,) Grape Rot (*Læstadia bidwillii* Sacc) and Ergot, (*Claviceps purpurea* Tul.) Mr. Craig contributes some notes on Promising Grasses of Montana, and Idaho, based upon personal observations made during a hasty trip taken at the suggestion of the Governing Board of the station.—In New Jersey, Mr. Hulst reprints at length from Worthington Smith's account in "Diseases of Field and Garden Crops," of Club-Root (*Plasmodiophora brassicæ* Wor.) Some personal observations are added.—Professor Kellerman makes a preliminary Report on Sorghum Blight (*Bacillus sorghi* Burrill) in the December bulletin

of the Kansas station.—Otto Lugger in the January Bulletin of the Minnesota station, publishes a paper on "Frosted and Rusted Wheat," apparently being for the most part a compilation from various sources.—The Spotting of Peaches and Cucumbers is treated by Professor Arthur in the January Bulletin from the Indiana station. The disease on peaches is caused by *Cladosporium carpophilum* Thuem, and that on Cucumbers by *Cladosporium cucumerinum* E. & A. Figures are given of various stages of the fungi.

BACTERIOLOGY.[1]

THE BACTERIA OF SNOW.[2]—In many countries, during several months, snow forms the natural covering of the earth. Waste materials of all sorts, which collect in houses, etc., in many villages and small cities are thrown out directly upon the earth, and in the winter the snow takes the place of the earth in receiving and absorbing contaminating matters. In the spring, the water from the melting snow makes its way into the earth, carrying with it various impurities, some of which may be pathogenic. Whether any change takes place in them during the long time the snow lies upon the earth or whether they enter the earth unchanged, is a question of much importance.

According to the author of this paper, at the time of his writing, there was little or no literature concerning the bacteriology of snow. A number of investigators too, had worked on ice, but no where could he find any reports of examinations of snow. It remained uncertain whether its long stay on the earth changes the number or the character of the bacteria contained in it.

In the bacteriological examination of snow, it is obviously of first importance to secure it pure and free from accidental impurities, as it is often found, for example, on a large clear expanse. As it was evident that there would probably be a difference between snow which had lain long on the earth and freshly-fallen snow, the author made investigations of both kinds. Of fresh snow, some was caught, while falling, during

[1] This Department is edited by Prof. Wm. T. Sedgwick, of the Mass. Institute of Technology, Boston, Mass., to whom brief communications, books for review, etc., should be sent.

[2] "Ueber den Bakteriengehalt des Schnees," von Th. Janowski. *Centralblatt für Bakteriologie* IV, 547.

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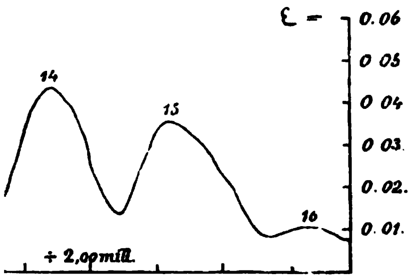

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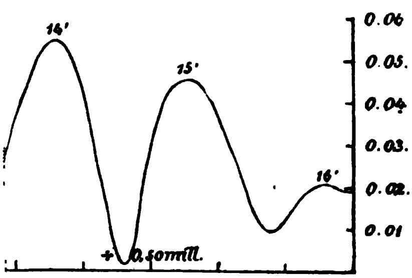

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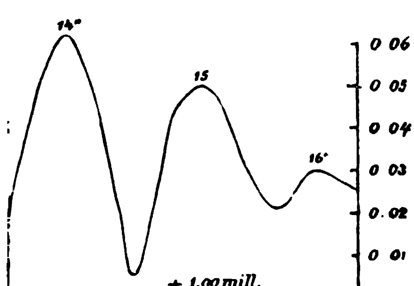

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a snow storm, in a sterilized tube. The snow so taken was melted in a water bath at 30° C. and .5 C.C. of this melted snow mixed with nutrient-gelatin. From this, plates were prepared in the usual way. Other samples of the same snow were also planted, and an average of these showed pretty well how many bacteria were ordinarily contained in such snow.

To insure as exact results as possible, two samples of snow were always taken from different places, and as free from contaminating matters as possible.

From fresh, falling snow, the following results were obtained:—

Feb, 2, 1888. Average temperature, — 7.2° C.
In the first sample 34 bacteria to 1 c.c. of melted snow.
In the second, 38.
Feb., 21, 1888. Average temperature — 11.1°C
In the first portion, 203.
In the second, 384.
Feb., 28, 1888. Average temperature — 12.2
In the first portion, 140.
In the second, 165.

Although these figures differ widely they nevertheless teach us something of the bacteriology of snow, and do not show wider differences than different examinations of ice, made by Fränkel, Prudden and others. A part of the bacteria found in snow are contained in the vapor when it crystallizes. Another, and the larger part, are filtered from the air by the cottony snow-flakes in falling. Consequently, the number of bacteria in the air must be much diminished, after a snow fall, and a true cleansing of the atmosphere appears to be accomplished, such as takes place during a rain. It is also clear that the cottony or wooly structure of the snow-crystal aids in producing this effect, in no small degree. Large differences sometimes noticed in like portions, might be due to the fact that during a snow storm, the snow may sometimes become mixed with impurities gathered from buildings in the vicinity, etc.

In studying snow which has been lying for some time Janowski took samples from the upper layers of snow which had fallen several days before, and which had since lain exposed to the air. In considering the results, it is important to know the range of temperature to which the snow was exposed. This was learned from the official weather reports at Kiew, where his investigations were made.

By means of a sterilized plate of glass he then removed the top of the snow, half a centimetre deep, on top of which the dust from the air rested. From the layer thus uncovered he took his samples and prepared plates as before.

Feb., 11. No snow since the morning before. Temperature during that time ranging from —8° to — 14°.

1st, in 1 c.c. snow water 2.

2nd, " " " " 4.

Feb., 15. No snow for four days. Temperature from —1 to —8°.

1st, portion 8 bacteria.

2nd, " 20 "

Feb., 24. Three days with no snow. Temperature between —11 and —21. Heavy frost.

1st portion 228 bacteria.

These figures seem to indicate that snow lying on the ground some time and exposed to low temperatures, always contains a considerable number of bacteria, and that the low temperature in winter exercises no considerable effect on the bacteria contained.

A number of different kinds of bacteria are contained in snow. Janowski found both those which liquefy gelatine, and those that do not, the former in larger numbers than the latter. He states that one point in particular interested him considerably, namely that he always found in plates from newly fallen snow, as in river water, many colonies which liquefy very rapidly while snow that has been long exposed to extreme cold contains few or none of these. He concludes that this kind, at least, is affected unfavorably by low temperature.—(*M. E. Dodd.*)

THE CHEMICAL ACTION OF CERTAIN BACTERIA.—A paper appeared in the *Journal of the Chemical Society* for August, 1888, by Robert Warington, on "The Chemical Action of some Micro-organisms." Some twenty of the organisms experimented upon were received as pure cultures from Dr. Klein, while six or seven others were isolated by the author himself. The action of these separate species was tested in four respects: 1. The hydrolysis of urea. 2. Action on milk. 3. Capacity for reducing nitrates. 4. Power of producing nitrification.

Warington finds that "the property of effecting the hydrolysis of urea is apparently but rarely met with among micro-organisms; in the present case, out of twenty-four organisms tried, only two could certainly be shown to possess it."

Of the action on milk he says: "The whole of the organisms which fail to gelatinise milk are organisms that do not liquefy gelatin. . . . On the other hand the whole of the organisms which act on milk as ferments liquefy gelatin. . . . . We may venture therefore to predict that every liquefy-

ing organism will be found capable of gelatinising the casein of milk."

As regards the reduction of nitrates, Warington states that out of twenty-five organisms seven were entirely without reducing power, one produced a mere trace of nitrite, and one only a very small quantity: the remaining sixteen reduced nitrates in broth, with considerable vigor. With the possible exception of one culture, the reduction to nitrites would appear to have occurred without the production of nitrogen, oxides of nitrogen, or ammonia.

The many investigations of the past few years on the relation of micro-organisms to the process of nitrification have met with little success so far as regards the isolation of a *specific* bacterium of nitrification. Warington's researches in this direction seem to have been little more fruitful than those of his predecessors. His experiments gave mostly negative results, and he concludes his paper with the observation : "An organism which nitrifies as soil nitrifies. has yet to be isolated."—(*E.O.Jordan.*)

BACTERIA, MICROBES, OR MICRO-ORGANISMS?—These terms are being used by various writers sometimes with precision but more often as synonyms. Etymologically "microbe" and "micro-organism" are equivalent terms, meaning simply "a little living thing." But "bacterium" meaning "a staff" is certainly not equivalent to the other two. An arrangement, perhaps as natural and simple as any, is to reserve the term *micro-organisms* for all forms of life which are so small that it is impracticable to study them to any great extent with the naked eye. "Micro-organisms" would then be a usefully indefinite term including many animals as well as plants, *e.g.* the protozoa, rotifers, many crustacea, indeed representatives of nearly every great group of invertebrates, diatoms, desmids, and other micro-algae, besides moulds, yeasts, bacteria, and other micro-fungi. The micro-organisms are only a general and very comprehensive group, divisible, for convenience, into two lesser groups.

These are, *1, the Microscopical* and 2, *the Bacterial micro-organisms.*

The *Bacterial micro-organisms* are those which are too small to be successfully studied individually and are best investigated in masses by special "cultures." They include the bacteria together with, perhaps, the yeasts and certain moulds.

The *Microscopical micro-organisms* are those which can be successfully studied by the microscope, individually, and without special "cultures." They include all animal micro-or-

ganisms, and all vegetal, excepting those just mentioned under the Bacterial division.

The term *microbe* may be left where it is now oftenest found,—in the newspapers.

The justification for such a classification as the above, is convenience, only. As a matter of fact quantitative; estimates of the numbers of micro-organisms in any given sample of water, air, ice or snow, are of fundamental importance. At present the bacteria are estimated by cultures, and the other micro-organisms in ways entirely different.[1]

ZOOLOGY.

THE PHALANGES OF BATRACHIA SALIENTIA.—Professor Howes and Mr. Davies read a paper before the Zoological Society of London, Dec. 4, 1888, on the distribution and morphology of the supenumerary phalanges in the Anurous Batrachians. The authors described for the first time the primary mode of development of a supernumerary phalanx. They concluded that the same is in the Anura identical with the interphalangeal syndesmoses, and that the syndemoses and phalanges are derivatives of a common blastema. In its fully differentiated condition the structure in question was shown to be functional in receiving the direct thrust under the weight of the falling body in saltation; all the variations in structure being readily intelligible on that view.

The authors discussed the bearings of the facts upon classification and upon the broader question of the morphology of supernumerary phalanges in general. They showed that the facts of development indicated a probable intercalary origin of the latter from the interarticular syndesmoses; and that the numerical increase of the phalanges in the Cetacea may have been associated with the loss of ungues, somewhat similiarly to the way in which the multiplication of segments of the cartilaginous rays in the paired fins of the Batoidei would appear to have been connected with the disappearance of horny fin-rays.

The authors also showed that the Discoglossidæ alone among the Anura retained for life the undifferentiated syndemoses,

[1] "A new method for the microscopial Examination of water." See *Science*, Feb., 15, 1889.

and that this feature testified more forcibly than anything else to their low affinities. They also described a community of structure between the modified syndemoses in certain Anura and the apparatus of the knee-joint in Mammals, and urged that the facts were such as to necessitate a reconsideration of the morphological value of the latter.

EMBRYOLOGY.[1]

New Studies of the Human Embryo.—M. C. Phisalix[2] gives a very complete account of a human embryo of one centimetre (two-fifths of an inch) long. The method of plastic reconstruction from a continuous series of sections is carried out for the entire embryo. The organs which receive special attention and reconstruction are the cranial nerves and nervous system, the disposition of the valves and septa of the cavities of the heart, the origin of the pancreas, and Wolffian bodies. Many points dealt with by His have been more fully elaborated or corrected by Phisalix. The reconstructions seem to have been carried out with great care and accuracy, that representing the relations of the cranial and spinal nerves from the side is very interesting; the same may be said of the reconstructions representing the alimentary canal and its appendages.

The origin of the pancreas from two distinct diverticula will be noted by specialists as a matter of interest The great length relatively of the bronchi at this stage and the acute flexure of the branchial region are very strikingly shown, while the crowding together of the branchial clefts and the diverticula from them which give rise to the thymus gland are admirably shown in their relation to adjacent parts. But as the memoir is hard to understand without the figures which accompany it, the reader is referred to the original for fuller anatomical details.

A curious fact is mentioned by the author in regard to the embryo described by him, viz., its want of perfect symmetry, though believed to be perfectly normal. The left side, especially the region of the cerebral vesicles, was found to be larger

[1]This Department is edited by John A. Ryder, University of Pennsylvania, Philadelphia.

[2]*Etude d'un Embryo humain de* 10 *millimetres.* Arch. de. Zool. Expr. 2 me Ser. vi. 1888. Nos. 2 et 3. pp. 280–350, planches xiii–xviii and figs. A.–F. in text.

than the right. The author asks, is this embryonic asymmetry peculiar to man? And also, does it bear any relation to the functional predominance of the right side over the left in the adult. This memoir is a valuable one, as it supplies a thorough study of one very important stage of the human embryo, and is a very creditable continuation of the work of His and Fol in the same direction.

ON THE DEVELOPMENT AND FIRST TRACES OF THE ANTERIOR ROOTS OF THE SPINAL NERVES IN SELACHIANS.[1]—This last of Prof. Dohrn's studies forms chapter xiv. of the *Studien zur Urgeschichte des Wirbelthierkörpers*; it is most suggestive as is all of his work. The problem of the origin of the anterior or motor roots of the spinal nerves has given rise to a great deal of speculation and discussion. It has been the good fortune of Dohrn to find in embryos of *Mustelus* and *Pristiurus* 3 mill. 5.5 mill. and 10 mill. long, conditions of the development of the anterior or motor roots which are of great importance.

1. The motor roots grow out at the lower angles of the medullary tube before the appearance of the white matter of the cord as conical or more or less produced extensions of the plasma of that tube. At first these roots contain absolutely no nuclei, but are simply homogeneous pseudopod-like processes.

2. Mesodermal cells next approach and sink into these plasmic processes. These probably have something to do with the development of the primitive sheaths of the future nerve fibres.

3. These plasmatic ventral processes from the medullary tube now blend over the extent of their outer surfaces with the still undifferentiated plasma of the adjacent cells of the protovertebræ or somites. Junction of the motor portion of the nervous mechanism with the tissue still to be converted into muscle is thus found to have taken place before even the formation of true nerve fibres or of muscular fibrillæ.

4. The next step in the differentiation of the motor roots is the migration of medullary cells into the above mentioned plasmatic processes from within the walls of the medullary tube. This seems to be conclusively established by the fact that the nuclei of medullary cells were seen in process of division at or within the bases of these processes.

It seems to be thus conclusively established that of the prim-

[1]Ueber die erste Anlage und Entwickelung der motorischen Rückenmarks nerven bei den Selachiern. Mitth. aus d Zool. Stat. zu Neapel. viii. 1888. pp. 441—461. Taf. 22.

itive constitution of motor nerves, neither fibres nor sheaths form a part. Neither are axis cylinders or medullary substance developed. End-organs or terminal branching ramifications of the nerve fibres do not as yet exist, but the capacity for their development is probably inherent in the simple structures and relations above described. The relations described by Dohrn are strongly opposed to the theory of the *ab initio* continuity of nerve and muscle by impalpably fine fibres, and if fully established fatal to Hensen's doctrine. It is needless to add that, while these new results are not wholly in accord with those of Balfour, they will probably serve to complete the true doctrine of the development of the spinal and cranial nerves, the foundations of which were first laid down by that remarkable investigator.

THE MATURATION AND FERTILIZATION OF THE EGG OF PETROMYZON PLANERI.[1] A. A. Böhm in this extended memoir gives a very complete resumè of the work of his predecessors upon the early history of the eggs of the lamprey. The formation of the polar globules is described, and the peculiar manner of union of the segments of the female and male pronuclei are illustrated. It seems that the chromatin substance of the head of the spermatozoon in this process always first breaks up into about four rounded segments or *spermatomerites* as Böhm calls them, which remain for some time lying close together in a straight or curved row.

PHYSIOLOGY.[2]

INHIBITION IN MAMMALIAN HEART.—Professor McWilliam continues[3] his work on cardiac physiology by a study of the phenomena of inhibition in the mammalian heart.[4] The results are given in considerable detail, and can be discussed here very briefly only. The effects of the stimulation of the vagus nerve on the auricles and on the ventricles are in general similar, consisting

[1] *Ueber Reifung und Befruchtung aes Eies von Petromyzon planeri*, Arch. f. mik. Anat., xxxii. 4 Hft. 1888. pp. 613—670. Taf. xxiv—xxv.

[2] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[3] See AMERICAN NATURALIST, Jan. 1889.

[4] *Journal of Physiology*, vol. 9., p. 345.

of a slowing of the rhythm, and a depression of both the contraction force and the conduction power of the muscle; but the functional relation of the vagus to the ventricle is not nearly so close and intimate as to the auricle. The condition and working of the auricular muscle are much more readily and more profoundly altered than are those of the ventricular muscle. Augmentation following the depression, as has been pointed out for the cold-blooded animals, is slight and inconstant, which would seem to be in opposition to Gaskell's idea of the vagus being an anabolic nerve. Section of the vagus causes in addition to the acknowledged acceleration of beat a marked aug mentation in the contraction force of both auricles and ventricles. As has been pointed out in cold-blooded animals, the author finds a local inhibitory area to exist in the mammalian heart, *i. e.*, a limited area, stimulation of which affects the ventricle in exactly the same way as stimulation of the vagus does. In the cat and dog this region overlies the auricular septum on the dorsal aspect of the auricles. The vagus fibres pass through or near it, but it evidently contains structures differing from the vagus in regard to excitability, relations to curari and certain other influences. While normally stimulation of the venous terminations or of the auricles causes an acceleration of beat, under certain abnormal conditions, *e. g.*, in a dying heart, such stimulation results in inhibition, thus indicating under such conditions a reversion to a physiological type normally obtaining in hearts of certain lower vertebrates.

MEETING OF AMERICAN PHYSIOLOGICAL SOCIETY.—The American Physiological Society held its annual meeting in Philadelphia, December 29 and 31, 1888. The laboratories of the Jefferson Medical College and the University of Pennsylvania were inspected, and laboratory methods were informally discussed. The following papers were presented:

1. E. T. Reichert.—"The Excitability of the Different Columns of the Spinal Cord."
2. E. T. Reichert.—"The Rate of Transmission of Nerve Impulses."
3. E. T. Reichert.—"A New Calorimeter."
4. J. W. Warren.—"On Sensory Reinforcements of the Knee-Jerk."
5. H. H. Donaldson.—"On the Changes in Ganglion Cells Due to Stimulation."
6. H. N. Martin.—"The Lethal Temperatures of the Cat's Heart."

7. H. N. Martin.—"The Influence of Light on the CO_2 Excretion of Frogs Deprived of their Cerebral Hemispheres."

The Council for 1888-9 consists of S. W. Mitchell, President; H. N. Martin, Secretary and Treasurer; H. P. Bowditch, J. G. Curtis, H. C. Wood.

Dr. S. Weir Mitchell placed at the disposal of the Society the sum of two hundred dollars to be offered as a prize for researches on the rate of transmission of nerve impulses in man, such researches to be completed at the end of two years.

PHYSIOLOGICAL PRIZE.—In accordance with the offer of Dr. S. Weir Mitchell to the American Physiological Society, the latter Society now formally offers to residents of North America the prize of two hundred dollars for researches bearing on "the rate of transmission of nerve impulses—afferent and efferent—and the duration of reflex and reaction time in the higher animals, especially man; also the conditions—normal and pathological—which alter such rates and times." The work must be done between Jan. 1, 1889 and Oct. 1, 1890. Further information may be obtained of Prof. H. Newell Martin, Baltimore, Maryland: Johns Hopkins University.

PROPOSED INTERNATIONAL CONGRESS OF PHYSIOLOGISTS IN 1889.—In accordance with the circular issued by the English Physiological Society, a meeting was held in Berne, Switzerland, in September, 1888, to consider the advisability of holding, during the present year, an international congress of physiologists. England, France, Germany, Italy and Switzerland were represented. It was decided to hold such a congress at Basle, beginning September 10, 1889. The subjects to be brought before the meetings include Anatomy, Histology, Physics, Chemistry, Experimental Pathology, and Pharmacology, in so far as they bear directly upon Physiology. All communications are to be as little formal and as fully demonstrative and experimental as possible. Professor Miescher and the Department of Education of the City of Basle have cordially approved the project. The committee of the English Physiological Society has been continued with executive powers to organize the Congress, and through a circular requests information concerning probable attendance, titles of intended communications, and details of apparatus required for demonstrations. American physiologists intending to be present may notify Dr. H. P. Bowditch (till July 1st), Harvard Medical School, Boston, Mass; (subsequently) care of Knautt, Nachod & Kühne, Leipzig, Germany.

MICRO-ORGANISMS AND DIGESTION.—The extensive researches which are now being carried on in regard to the relations of bacteria to disease increase our interest in any addition to our knowledge of their connection with the normal activities of the body. Drs. Harris and Tooth, of St. Bartholemew's Hospital, have undertaken a series of experiments to investigate the relations of micro-organisms to digestion, and have published a preliminary communication on the subject.[1] They find it easy to prove that proteids can be digested by pepsin independently of micro-organisms, but have not succeeded in establishing the converse proposition, namely, that micro-organisms can of themselves convert proteids into peptone. In experimenting with trypsin it was found necessary to employ antiseptics in order to make sterile experiments. With mercuric chloride, 1 to 2 per cent. neither peptone nor bacteria appeared, with carbolic acid, 1 to 2 per cent. peptone was abundant but bacteria absent; while iodine interfered neither with the digestion nor the development of bacteria. It was thus proved that the pancreatic ferment, like the gastric, can digest proteids without the aid of micro-organisms.

It was found that the formation of leucin and tyrosin is probably due at least in part to the action of bacteria, and that the formation of indol seems to be entirely dependent upon it. The results of experiments indicate that there are special indol-forming organisms, in the absence of which this substance does not appear.

These conclusions are in substantial accord with views which have been previously entertained, though hitherto they have been accepted without adequate experimental proof.—*M. A. Johnson.*

PSYCHOLOGY.

OBSERVATIONS ON PUTORIUS VISON.—On July 6, 1887, while engaged in geological work on the Cedar River, near Osage, Iowa, my attention was attracted by the peculiar actions of a Mink (*Putorius vison.*) By careful maneuvering, we were enabled to approach to within a short distance of where it was engaged, and there watch its behaviour unobserved. It was an old mother Mink engaged in fishing, for her young.

[1] Journal of Physiology, vol. 9, No. 4.

On the ripples in the center of the stream, where the water was not more than two feet in depth, was a flat Drift Bowlder rising a few inches above the surface. On this rock the mother Mink would take her position, and here watch for small fish to approach, when she would dive into the water, be gone for a moment, and then reappear on the opposite side of the rock, usually with a fish in her mouth, which she would deposit in the center of the stone, and its struggles instantly stop by a quick sharp bite back of the head, which caused immediate death. This process was repeated without intermission, except to stop for an instant to shake the water from her furry coat, until seven fish varying from four to seven inches in length, were deposited on the rock. Then, without stopping to rest, taking one of the fish in her mouth, she plunged into the stream and swam to the shore, climbed the steep bank and ran hastily to her young, in a burrow under an old stump on the bank of the stream, fifty yards away. In a moment she was seen returning, plunged into the stream and swam to the rock, took a second fish in her mouth, entered the river once more, and returned to her young as at first.

This was repeated until all the fish had been carried away. A few moments after having removed the last fish, she returned and began her work once more. This time, however, her labors were without result, so, shifting her position to another rock in the stream, a short distance away, she continued her fishing. But although more than a quarter of an hour was spent in energetic effort, her labors were without avail, and she was this time compelled to return to her young "empty handed."

After waiting for some time, we crossed the stream to examine the burrow, but before going half way, the old Mink was met returning to her fishing ground. From the bank of the stream, where egress from the water was made, to the burrow, fifty yards distant, a well beaten path had been formed by the mother Mink in her daily excursions in quest of food for her young. Not wishing to destroy the burrow (which would have been necessary) the number and condition of the young was not ascertained. How long this Mink had been engaged in fishing before our attention was attracted to her, or how long it would have been continued, had she been undisturbed, it is difficult to say. But it is true that a degree of parental love and affection, (if we may so term it,) was evinced by the mother Mink for her young, in thus so indefatigably laboring, under a scorching July sun, to procure them food, as it is but rarely witnessed.—*C. L. Webster.*

A PECULIAR HABIT OF THE BLACK BASS.—I once observed a singular race between a Black Bass (*Micropterus dolomieu*,) and a soft shelled Turtle (*Aspidonectes spinifer*) and her young. The first noticed was the old Turtle and her young swimming steadily up stream, turning neither to the right hand or to the left, (an unusual occurrence, so far as my observations extend,) and closely followed by a large Black Bass. Both the mother Turtle and her young appeared very much exhausted, and would very often come to the surface for air. The young Turtle, if not disturbed would swim close behind its mother, but the Bass, who was always hovering *over* or following a foot or so in the rear, would often make a lunge for the young one, and apparently bite it, which would cause it to instantly dart *under* its parent, and swim in this position until compelled to come to the surface to breathe. The young one finally became so exhausted and worried by the Bass, that at three different times it was observed to lay hold of the edge of its parent's shell with its mouth, and thus compel her to take it in tow. Not the slightest attention was paid to the young one by its parent.

Several times two or three Red Horse ?(*Moxostoma macrolepidotum*,) attempted to join in the chase, but was each time immediately driven away by the Bass. This performance was watched some time by me, and when the trio was last seen, the "play" was still going on.

We have at other times and in other places, observed this Turtle to be followed by Black Bass. This has also been observed by Dr. Kirtland, (Geological Survey of Ohio, Vol. IV, Zoology and Botany, P. P. 668—669.) Whether the Black Bass is a natural enemy of this species of Turtle, or what its real intention may be in so often following it, we are at present unable to say.—*C. L. Webster.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHROPOMETRY.—Anthropology in its literal sense is Man Science. It deals with the structure, history and development of men. The complexity of man in nature gives birth to many sciences. Some of these are old and some are new.

1. This Department is edited by Thomas Wilson Esq., Smithsonian Institution, Washington, D.C.

By their aggregation or consideration there was born a new science absorbing all the others, forming a harmonious whole, the substance of which is the natural history of man, and the name, Anthropology.

Notice the complexity of the subject and when the science comes to be divided into its distinctive parts, each of which is large enough to form (and in times past some of these have formed) a science in itself and given ample scope to the student for a lifetime.

1. Antiquity of man.
2. Origin of man.
3. Man's place in nature.
4. The races of mankind.
5. Language.
6. Development of Civilization.
7. Anatomy and Physiology of man.
8. Anthropometry or the measurement of human attributes whether physical or mental.
9. Psychology and Biology.

In former times, Archæology, classic, or otherwise, assumed control over much that has now been absorbed in Anthropology. The distinction between the two sciences is at present well defined, and they are now represented by different organizations.

Folklore and numismatics are powerful aids to Anthropology, insomuch that the student of one involuntarily becomes interested in the others. I predict their final absorbtion by the larger and more comprehensive science.

Numbers 1, 2, 3 and 8 in the foregoing list are new sciences. Their names may not be new, but they have, within the past few years, outgrown their former surroundings—burst their shell, so to speak, and now have assumed a position as part of the great science of Anthropology. The novelty of the antiquity and origin of man will always render this study attractive. They will always find their students and devotees. They deal with, that which to us are the great mysteries of the universe; the Whence, the How, and possibly the Whither, of the Human Species.

But number 8 is in danger of neglect at the hands of scientists. It is not attractive. It requires the utmost precision and care. Its results must be recorded, with all their errors. These may be detected in future investigations, and thus return to torment their originator. The work consists largely of dreary wastes of figures carried out to fractions of thousands, registered in a (to us) foreign system—the metric; and what-

ever of interest it may have, that of comparison, either with its own race or with others, does not commence until the future. So it has come to be neglected; but its importance to a study of Anthropology, which shall be at once scientific and valuable, cannot be overestimated. To the doubter of this proposition I propound the following question: How can you determine the different races of mankind except you consider the difference of size, color, form and capacity. And how can this be done without Anthropometry?

The number of divisions into which it has been proposed, at different times, and by different scientists, to separate mankind has ranged from two to sixty. The five great divisions which we were taught as children have been broken up and the later scientists have proposed but three, to which they have given Greek names signifying the particular attributes assigned to each group, instead of the geographical terms formerly employed.

Leucochroi—represented by the Europeans.

Mesochroi—by the Mongolian and American Indian.

Melanochroi (Huxley) or Æthochroi (Dallas)—by the Negro and Australian.

The basis on which this classification has been made is as follows:

1. Statue and comparative height of different parts of the body.
2. Color of skin.
3. Color of hair and eyes.
4. Index, Cephalic.
5. Index, nasal.
6. Cross section of hair.
7. Shape of nose, and in certain cases (to be determined after death), of the pelvis.

From these facts given in figures with the necessary precision, aided by a study of his language, the scientist determines to what division of mankind the individual who is under examination belongs. But I ask how can these facts be gathered except by use of Anthropometry?

This new science of Anthropometry has grown so that what was before unthought of, and perhaps supposed to be unattainable, is now within the commonest demands. The time was when the stature and weight of the human body, the diameter and cubic capacity of the human skull, and the weight of the brain, were about all expected from Anthropometry. But an extended consideration shows that there is little in the Science

of Ethnology, in the study of physical difference between the races of mankind or the individuals thereof, which Anthropometry may not aid in clearing or defining.

Think of the physical differences in the various races of mankind in the present day—take the Western Hemisphere, and beginning at the north, compare the physical differences susceptible of accurate measurement between the Eskimos, Aleuts, Innuits, the North American Indian, the Aztec, the Peruvian, the Patagonian. A moment's consideration will carry conviction that accurate measurement would go far in establishing the dividing line between these races. As to the like benefit among our present Indians, in deciding between different tribes, I offer no opinion, but in obtaining by Anthropometry their status as a race, for comparison with other races, and so fixing their relative position as an Ethnologic group, I have no doubt as to the benefit, and that the work if done would receive the approval of the scientific world. Especially is this true since the combination of the American Indian in the same grand division with the Mongolian. I know of no method, except by Anthropometry, that the comparison between these two peoples can be made with precision; or by which they can with certainty be assigned to the same grand division. This comparison cannot be made by the measurement of a few isolated cases in either continent. The measurement must be of groups of individuals sufficiently large and numerous to establish the peculiarities of the entire people.

This application of Anthropometry to the American Indian falls naturally to the scientist of the United States. None other can do it, and our national pride should say that none other be permitted to do it. If this is a proper work, and worth the doing, it should be done by us. We should here apply the Monroe doctrine of politics. If not done, it should not be because it was neglected, or forgotten; but because we decide it not to be worth the labor and expense, and in this we must justify ourselves in the eyes of the world.

I venture with diffidence the suggestion that the present tried corps of Ethnologic explorers among our Indians might add to their present field duties that of Anthropometry. The corps is already organized and the labor, trouble or expense would be but slight compared with what it would be if a new corps had to be organized. The expense would only be for instruments and tables. The men could receive instructions in the needed manipulations from competent professors before starting. With small practice they could soon master the art,

and learn to measure the human body with celerity and precision, and to record the results with certainty. Of course, the collating these results would be done after their return home by others. The proper professors would afterwards determine the conclusion established by this aggregation of facts.

So important has this science of Anthropometry been considered in Europe that one of the most studious, learned and enthusiastic professors of Anthropology in the world—he who probably stood nearest its head—Paul Broca, devoted himself principally to the study and practice of Anthropometry; he developed the system which bears his name, and his fame stands principally upon his services in this branch. The Societè d'Anthropologie at Paris endorsed his system, published his instructions as its own, and now the world has almost entirely adopted it as the basis of Anthropometry. The necessity of uniformity is so apparent that each country, one after the other, has finally adopted the metric system of measurements, England, I believe the last.

This Societè established, many years ago, a permanent course of lectures upon this subject; one each week during the scholastic year. Broca was the lecturer during his lifetime. This course is still continued and is now in the hands of Broca's successor, Dr. Manouvrier. Anthropometry is thus assigned a place equal in dignity with any other of the branches of the science.

Dr. Paul Topinard is now devoting himself to a work with a duration of many years, of making a chart of all France according to the color of the hair and eyes of the inhabitants. Mr. Francis Galton of London, has been engaged for years upon the work of "Heriditary Stature." He established an Anthropometric Laboratory at the Health Exhibition in London, 1883, where each individual could be measured, weighed and tested in all his parts, the record being furnished him and a duplicate being kept for scientific use, all for 3d. 10,000 people were measured. This system has been continued during subsequent exhibitions —the Fisheries, Colonies, Inventories, &c., and the South Kensington Museum has adopted it permanently. Mr. Galton reports that demands have been made from many places throughout the world for lots of machinery. I listened with much satisfaction to his address on this subject as President of the Anthropological Section of the British Association for the Advancement of Science at Aberdeen in 1885. He then stated the problem which he sought to elucidate; given a group of men, or a single man of any certain and known

stature, and ignoring every other fact, what may be the probable average height of the brothers, sons, nephews and grandchildren respectively, and what proportion of these will probably range between any two specified heights? He found the average height of man in Great Britain, at what he calls the "level of mediocrity" to be 5 feet 8¼ inches. He was able to transmute female to male heights by multiplying by 1.08, or as he says, to state it roughly, add one inch to each foot He established the ratio of height between brothers, between father and son, uncles and nephews, between grandfathers and grandchildren, and calculated the probability for the future. He proved that with all the certainty of divergence in height in individual cases, there was a law which tended to bring the whole people towards their mean level—that the progeny of tall men grow shorter and that of short men taller. And he adds the important fact derived from his study of "Hereditary Genius," that the peculiarities of mankind, say of Genius, follow the same rule. This rule seems reasonable and wise, otherwise while the children of the good people would become "very, very good," yet those of the evil people would become even worse than "horrid," and as the evil are numerical by greater, the world, but for this rule, would soon be given over entirely to evil.

The Societè d'Anthropologie at Paris has issued a full set of instructions adapted to nearly all parts of the world.

General instructions are printed with particular instructions for France, for Australia, Algeria, Peru, Senegal, Mexico, Chili, Sicily, the Red Sea, Cambodia, Central Asia, Maylasia, Madagascar, each separate, but together forming a volume of not less than a thousand pages. Travelers to any of these countries are recommended to provide themselves with these instructions and the necessary instruments, and take observations to be reported back to the Societé. The same general course has been pursued by the principal societies in Europe. I will not attempt to give even a list of the reports made in accordance with these recommendations, such would be so incomplete that it would mislead rather than inform the reader. But it may be summarized by saying that about all we know *with certainty in figures* of the physical characteristics of the various peoples of the world we know from these sources.

I give a sample of the information thus received, a resumé of the report made by Surgeon H. B. Guppy of his visit to the Solomon Islands. He operated upon 72 natives and gives the tables of measurements in every part of the body. His resumé

of the physical characteristics of the average Solomon Islander is as follows: (*Anthrop. Institute*, Vol. XV, p. 281.) "Such a man would have a well proportioned physique, a good carriage and well-rounded limbs. His height would be about 5 feet, 4 inches; his chest girth between 34 and 35 inches and his weight between 125 and 130 pounds. The color of his skin would be a deep brown, corresponding with number 35 of the color-types of M. Broca. * * * The form of his skull would be Mesocephalic. The proportion of the length of the span of the extended arms to the height of the body, taking the latter as 100. would be represented by the index 106.7. The length of the upper limb would be exactly the one-third the height of the body, and the tip of his middle finger would reach down to a point about 3½ inches above the patella. The length of the lower limb would be slightly under one-half 49-100 of the height of the body, and the relations of the lengths of the upper and lower limbs to each other, would be represented by the intermembral index 68.

I grant at once that there are other branches of Anthropology in the United States which have pressing needs for study. The Indian is said to be in progress of extinction like the buffalo, and unless he can be studied soon, in his language, art and industry, it will be too late. This argument for immediate action is all powerful, and should move the United States to all possible exertion. But I submit that it applies with equal force to Anthropometry. If not now, or soon, measured in their groups of tribes, it will be too late. Extinction or mixture of blood between different tribes or with whites would be equally fatal to Anthropometry.

Some of those who have studied the subject most, believe in an identity of race between the North American Indian and the mound-builders of prehistoric times. Anthropometry would be a powerful assistant in proving the fact.

I should much like to see Anthropometry practised upon our native tribes, whether Eskimo, Innuit or Indian, now while we have such splendid opportunities, by means of numerous examples and continued tests so extended and applied to groups of sufficient numbers, as that the physical peculiarities and attributes of each race or tribe might be established upon a scientific basis with mathematical accuracy, and which would be so complete as to be accepted by all the world. For this great subject the United States possesses peculiar facilities.

These would furnish means of comparison between them and all other tribes, races and peoples, whether modern,

ancient or prehistoric. I have wondered often that this most feasible and certain evidence has never been sought by the believer in identity of the North American Indian with the lost tribes of Israel.

The prehistoric race of men in Europe and America belonging to the paleolithic age—the river drift man and the cave dweller—were of much greater antiquity that the mound-builders of the United States, and the savants of Europe seem now to be of the mind that he passed, whether by land or sea is immaterial, to America, and that the Western Hemisphere is peopled from this stock. They think they can trace similarities of implement, art and industry in the present race of Eskimos. How much it would add to the solution of the question to have the physical status of each and all these tribes settled by Anthropometry.

The scientific value of anthropometry is for comparison between different individuals, or tribes, or races of people. In order to accomplish this comparison the measurement must be accurate and done by the same system among all nations. If different systems be employed, the comparison cannot be made with certainty. The tendency of the American mind to invent new systems should be here repressed and we should adopt as universal the metric system of measurement.

ANCIENT MOUNDS AT FLOYD, IOWA.—On the west side of the Cedar River, one half mile east from Floyd, Iowa, are located a group of three ancient mounds. These mounds, instead of being located on the highest eminence in the region, as is most usually the case, are arranged in a slightly curved line, on a high but level space, fifty feet above, and two hundred and twenty yards back from the stream, and midway between two points (from fifty to sixty rods from each) which face the river, and rise from twenty-five to fifty feet above this level space. The ground, between the mounds and the Cedar, has a rather gently sloping surface. At this point the stream makes a bend to the east, and the mounds thus occupy a position on the south side. The north side of the stream is occupied by a steep, and somewhat broken, wooded bank, which affords a limited though beautiful bit of scenery to this place.

This area, as well as the surface of the mounds themselves, was originally possessed by a heavy growth of timber, but which was cleared away more than twenty years ago and the soil kept under the plow ever since. These mounds are low and circular, and twenty feet distant from each other. The

east, or largest mound, is thirty feet in diameter, and was originally two feet high (so reported by Mr. Sharkey, who first cleared, and still owns the tract) although owing to degradation by the plow now rises only one and one half feet above the surface of the ground surrounding the mound. The two remaining mounds are smaller and lower than the first one. The third mound—there may be some slight doubt expressed regarding its origin, for the reason that in the south portion of it there is imbedded a drift bowlder, weighing some seven or eight hundred pounds. This, however, may have been placed here by human hands in the long ago, or the mound may have been an intrusion upon the stone. A partial exploration of the two smaller mounds was made, but without discovering anything.

In making a thorough exploration of the larger mound, however, the remains of five human bodies were found, the bones, even those of the fingers, toes, etc., being, for the most part, in a good state of preservation. First, a saucer or bowl-shaped excavation had been made, extending down three and three-fourths feet below the surface of the ground around the mound, and the bottom of this macadamized with gravel and fragments of limestone. In the centre of this floor, five bodies were placed in a sitting posture, with the feet drawn under them, and apparently facing the north. First above the bodies was a thin layer of earth; next above this was nine inches of earth and ashes, among which was found two or three small pieces of fine-grained charcoal. Nearly all the remaining four feet of earth had been changed to a red color by the long continued action of fire.

All the material of the mound, above and around the bodies, had been made so hard that it was with great difficulty that an excavation could be máde even with the best of tools. The soil around the bodies had been deeply stained by the decomposition of the flesh. The first (west) body was that of an averaged sized woman in middle life. Six inches to the east of this was the skeleton of a babe. To the north, and in close proximity to the babe, were the remains of a large, aged, individual, apparently that of a man. To the east and south of the babe were the bodies of two young, though adult persons. The bones of the woman, in their detail of structure, indicated a person of low grade, the evidence of unusual muscular development being strongly marked. The skull of this personage was a wonder to behold, it equaling, if not rivaling in some respects, in inferiority of grade, the famous "Neanderthal

PLATE VIII.

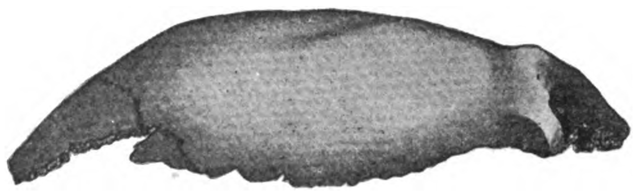

FIG. 1.

FIG. 2.

Fig. 1. A Lateral View of Skull of Mound Builder. Fig. 2. Front View of the Same. Both much reduced.

Skull." The forehead (if forehead it could be called) is very low, lower and more animal like than in the "Neanderthal" specimen. The two following cuts will illustrate this description.

This skull is quite small for an adult individual. The inner portions of the brow ridges are slightly prominent.

The distance from the lower portion of the nasal bone to the upper margin of the eye cavities is only four centimeters. A slight portion of this bone has, however, apparently been broken away.

The distance between the eye sockets at a point midway between the upper margin of the eye cavities and the lower portion of the nasal bone is two and three-fourths centimeters. Only that portion of the skull figured was found intact, the other portions being too much crushed by the weight of the earth from above to allow of a reconstruction of its parts. One of the jaws, containing well preserved teeth, was found. This was rather strong, but the teeth only moderately so. We were at first inclined to consider the strange form of this skull as due to artificial pressure while living, but a critical examination of it revealed the fact that it was normal, *i.e.*, not having been artificially deformed. The teeth of the babe were very small, and the skull thick, even for an adult person.

The next skeleton was that of a man nearly six feet in height. The crowns of all the teeth had been very much worn down, some of them even down to the bone of the jaw.

As before stated, the remaining bodies were those of young adult persons, the skull of one of which was small for a full-grown individual. No relics of any description were found with the human remains in this mound. This burial appeared to be a very ancient one, the limestone fragments in the floor of the excavation being nearly if not all decomposed.

In other mounds opened[1] on the same stream, at Charles City, six miles below, fragments of the same limestone was not infrequently found, but in no case was decomposition visible, except as a thin outer crust, although the human bones, which were usually more or less abundant, were in no case very well preserved, but on the contrary, often nearly or entirely decomposed. The fine preservation of the remains in the

[1] These mounds are thirty-one in number, an exploration of nearly all of which has been made by the writer and the results embodied in a paper soon to be published. A comparison of the method of burial practiced by the Mound Builders near Floyd, and by those of Johnson County, Iowa, (a description of which has been given by us in a paper on "Ancient Mounds in Johnson County, Iowa," and which has been in the hands of the printer for some time) will be of interest.

mound at Floyd was due to the method of burial. This being evidenced by the fact that over a small portion of one of the bodies the earth had not been so thoroughly packed, and as a consequence the bones were almost entirely decomposed away, while the other portion of the body over which the soil had been very firmly packed was well preserved. Judging from all facts gathered, it seems not improbable to suppose that this represented a family burial.

The question has been raised, "How was it that these five persons were all buried here at the same time, their bodies being still in the flesh?" As we have no reason to suppose that these ancient people possessed any means for preserving, for any length of time, in the flesh, the bodies of their dead; it seems plausible to suppose that these individuals were all swept off at about the same time by some pestilence, or else, upon the death of some dignitary of the tribe or people (perhaps represented by the remains of the old man) the other members of the family were sacrificed, similar to the custom which has prevailed among some ancient tribes or races of historic times.

On the same stream, a short distance below this mound, several other mounds occur which promise to yield interesting results, and which we purpose to explore as opportunity offers. —CLEMENT L. WEBSTER, *Charles City, Iowa.*

MICROSCOPY.[1]

THE EGGS OF PETROMYZON.[2]—1. Artificially fertilized eggs were treated with Flemming's fluid, containing a larger admixture of osmic acid than is prescribed in the original formula.

2. After 30 minutes the eggs were washed in distilled water, passed through 30% and 70% alcohol (3 hours in each), and preserved in 90%.

3. The eggs were cut in paraffine, the sections fixed to the slide with albumen, stained with safranine, and mounted in xylol balsam.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] A. A. Böhm, *Arch. f. Mikr. Anat.*, xxxii. pp. 634-5.

CENTRAL NERVOUS SYSTEM OF LUMBRICUS.[1]—If the earthworm is to be sectioned in toto, it is necessary to remove the sand from the alimentary canal. For this purpose, place the worm in a glass cylinder partly filled with fine bits of wet filter-paper. As the paper is swallowed the sand is expelled, and at the end of about two days the alimentary tract is cleansed.

In the study of the ventral cord, Friedländer employed the following methods:

Place the worm in water, to which a little chloroform has been added, and it soon becomes stupefied in an outstretched condition. Then cut open the body-wall along the median dorsal line, and pin the edges down in a dish covered with paraffine or wax. After removing the alimentary canal, the specimen may be treated with a preservative fluid.

1. *Osmic acid* 1%. After an exposure of about half an hour, the worm is sufficiently stiffened to allow the pins to be removed, and it may then be cut into pieces of any desired length. The pieces are then left twenty-four hours in the same solution, then washed, and passed through the usual grades of alcohol. Preparatory to embedding in paraffine, the pieces are saturated with chloroform or toluol. This method is excellent for the study of the neuroglia-like elements, and is the best for the brain.

2. Preparations treated thirty minutes with osmic acid (1%) are transferred to a dilute solution of pyroligneous acid (1 part to three parts water), which reduces the osmic acid very quickly. This is followed by alcohol as before. The ganglion cells are well preserved.

3. The preparation is first treated with weak alcohol, then with stronger grades. After half an hour in 70% alcohol, it is stiff enough for removing the pins, and for cutting into small pieces. Nerve fibres are somewhat contracted by this method, and are thus more easily distinguished from the surrounding connective tissue.

4. Corrosive sublimate (aqueous sol.) and 50% alcohol in equal parts (thirty minutes) gave good preparations of the nerves and the neural tubes.

For preparations according to No. 3, the best stain is a modified form of Mayer's alcohol carmine, absolute alcohol being substituted for 80%. Sublimate preparations are successfully stained with Grenacher's hæmatoxylin. After half an hour in this staining fluid, the preparations are transferred to acidu-

[1] Benedict Friedländer, *Zeitschr. f. wiss. Zoologie*, XLVII, 1, 1888, p. 48.

lated alcohol (50%, with a little hydrochloric acid) ½ minute, then placed in alcohol containing a few drops of ammonia. Connective tissue and nerves are unstained, while ganglion cells are stained deep blue.

The last two methods of staining may be followed by picric acid, which stains the uncolored elements yellow. The process is as follows:

After the sections have been fixed to the slide with collodion and the paraffine dissolved with turpentine or zylol, the slide is placed in turpentine containing a few drops of a solution of picric acid in absolute alcohol. In a few seconds, nerve-fibres, connective tissue, and muscles are stained yellow. The slide is next to be placed in turpentine containing a few drops of alcohol, to wash away the excess of picric acid, then in pure turpentine or xylol preparatory to mounting in balsam.

ZYLOL DAMMAR.[1]—M. Martinotti advocates the use of dammar dissolved in zylol as a mounting medium, to be preferred to balsam in certain cases. He prepares his solution in the following way:

Forty grams of dammar and forty grains of zylol are mixed together in a stoppered bottle and allowed to stand for three or four days at the ordinary temperature; the solution is then filtered. The filtrate, which will amount to about 70 grams, is then evaporated in a water-bath down to about 45 grams.

The object of this concentration is to obtain a solution of the resin in the smallest quantity of zylol possible, just enough in fact to merely dissolve the resin. This concentrated solution becomes yellow, but retains its limpidity. The next step is to dilute this solution with oil of turpentine, by which means the yellowish color is made to almost disappear.

[1] *Journal Roy. Micr. Soc.*, Feb. 1888, p. 153.

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AN ILLUSTRATED MONTHLY
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

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CONTENTS:

NEW YORK:
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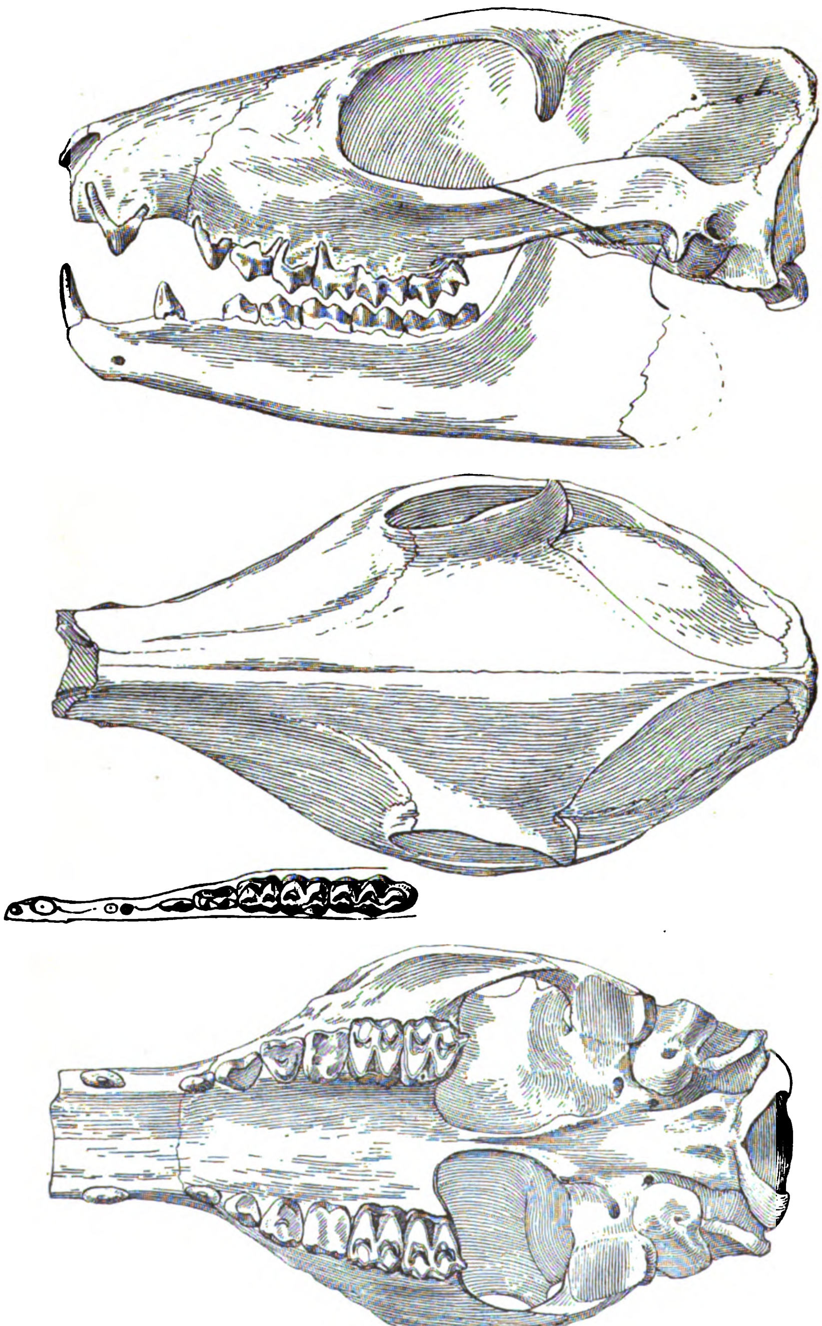
PLATE VI.



Hypertragulus calcaratus Cope. ½. (The pterygoid region injured).

THE

AMERICAN NATURALIST.

VOL. XXIII. APRIL, 1889. 268.

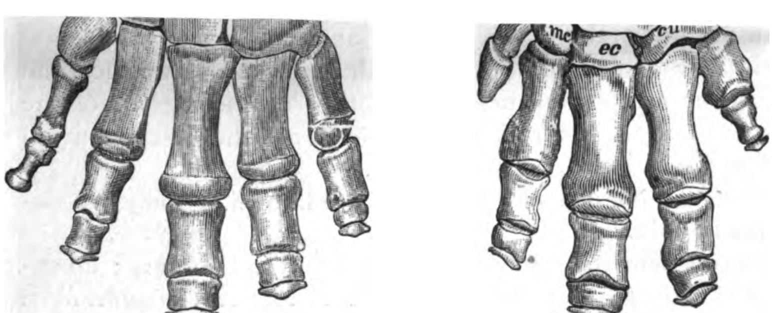
THE PROBOSCIDIA.

BY E. D. COPE.

THE Proboscidia are Ungulata in which the second row of [illegible] so as to alternate

ERRATUM.

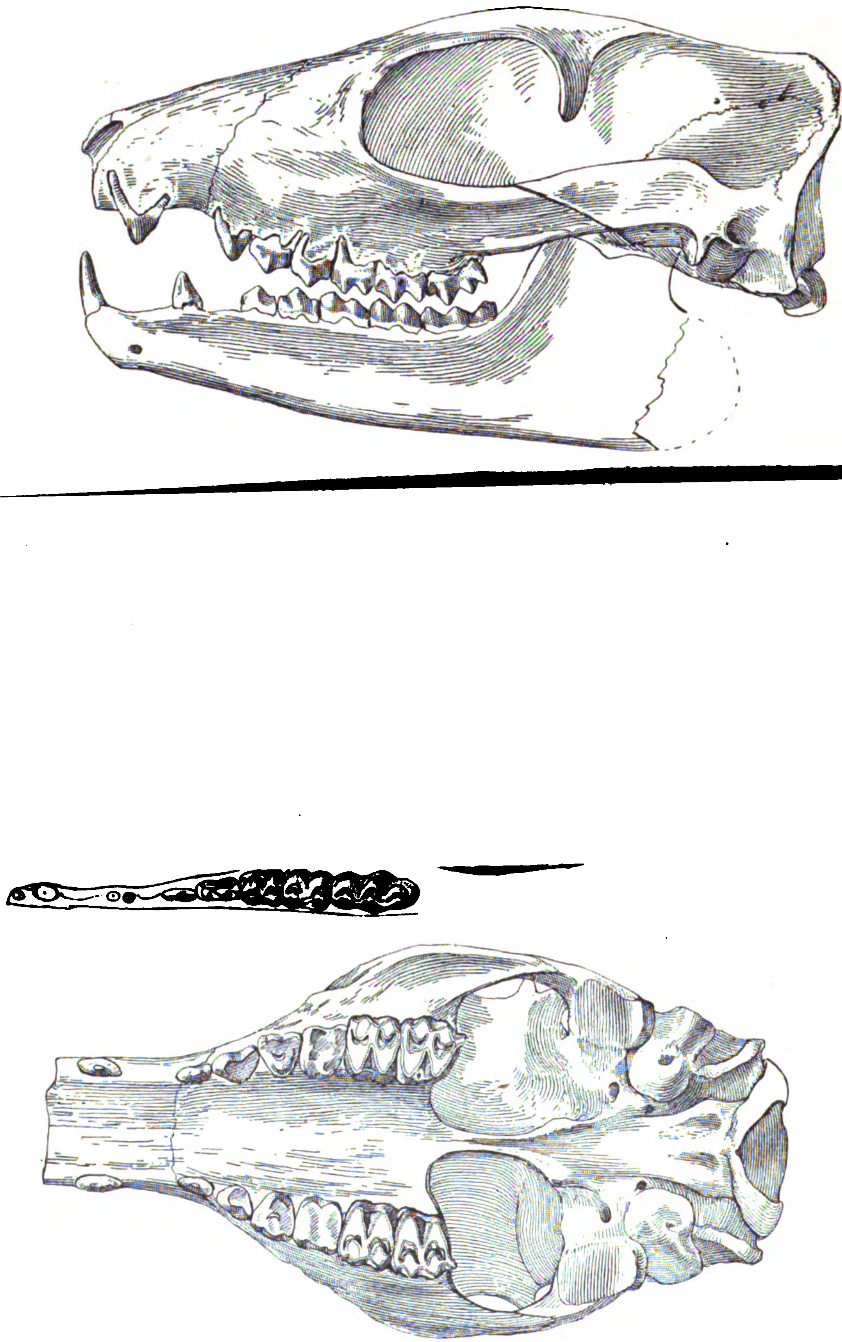
Fig. 9, page 208, should read "1/7.7 natural size" in place of "natural size."



A B

Fig. 1. Feet of species of Elephas much reduced. A, manus of *E. africanus*. B, pes of *E. indicus*.

PLATE VI.



Hypertragulus calcaratus Cope. $\frac{1}{1}$. (The pterygoid region injured).

THE

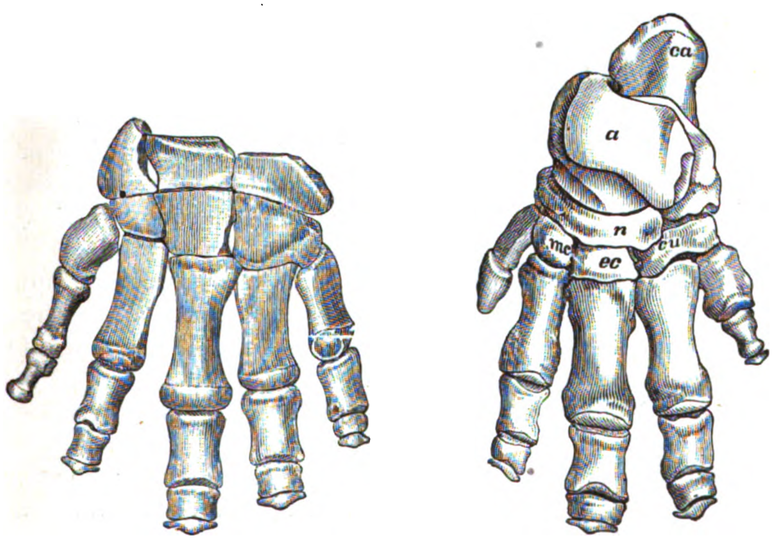
AMERICAN NATURALIST.

VOL. XXIII. APRIL, 1889. 268.

THE PROBOSCIDIA.

BY E. D. COPE.

THE Proboscidia are Ungulata in which the second row of carpal bones has not moved inwards so as to alternate with the first, and in which the second row of tarsal bones alternates with the first by the navicular extending over part of the proximal face of the cuboid. The teeth are modifications of the quadritubercular type, and canines are absent.



A B

Fig. 1. Feet of species of Elephas much reduced. A, manus of *E. africanus*. B, pes of *E. indicus*.

To these general characters are added numerous subordinate peculiarities in the known genera and species, which make them among the most remarkable of living beings. These peculiarities are the result of a long period of development. It is one of the most curious facts of paleontology that the order does not make its appearance until the middle of the Miocene system, and the greater number of forms do not appear until the upper Miocene. That it existed earlier cannot be doubted, and that it originated from some Eocene condylarthran is evident; but the intermediate forms are entirely lost to us as yet, and the phylogeny of the order is absolutely unknown. This is the more extraordinary since the earliest known genus (Dinotherium) embraces only species of colossal size, and its immediate ancestors could not have been insignificant. We may regard Phenacodus as the first form we know of earlier than Dinotherium, but what a hiatus is expressed in this statement! It is to be anticipated that the gap will be filled by discoveries in Asia, or the Southern Hemisphere. South America may be probably excluded from this prospect, since the extensive researches made there by Burmeister, Ameghino, and Moreno, have not resulted in the discovery of any Proboscidia earlier than the Pliocene. Asiatic investigations have revealed nothing, as the proper formations have not been found, and the same is true of Africa. So we shall have to wait until the paleontology of the present home of the order is exposed to view, before we shall know of the steps which lead from Phenacodus to these mighty monarchs of the animal kingdom. The absence of primitive Proboscidia from North and South America and Europe, impels us to believe that the representatives of the order known to us from those regions, are the descendants of immigrants from Asia and Africa.

But two families of Proboscidia are known. They are defined as follows:

Adult dentition embracing premolars and molars; no superior incisors................................*Dinotheriidæ*.

Adult dentition embracing one or two true molars only; superior incisors................................*Elephantidæ*.

The family of the Dinotheriidæ embraces one genus and

four species, though a fifth species, *D. sindiense* Lyd., from India, may belong, according to Lydekker, to another genus. The *Dinotherium indicum* Falc. is known from a few teeth, which exceed in size those of the other species. The *D. giganteum* Kaup is found in several Miocene deposits of Europe. It was one of the largest of Mammalia, its femur exceeding in dimensions that of any other land mammal. The inferior incisors were robust and cylindric in form. With the symphysis of the lower jaw they are decurved so as to form a most effective instrument for the tearing up of trees by the roots, or the pulling down of their branches The temporal fossa is lateral, and the top of the head flat. The premaxillary region though toothless, is prominent, and the nasal bones do not project. There is supposed to have been a short trunk. The skull measures three feet eight inches in length. (Plate XV.)

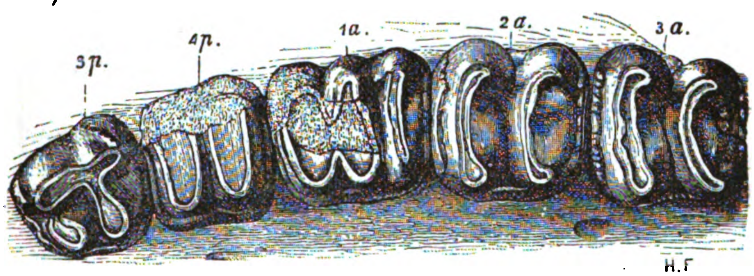


Fig. 2. *Dinotherium giganteum* Cuv. left superior molars, one fourth nat. size. From the Miocene of France. From Gaudry.

Two smaller species are known, the *D. bavaricum* from European, and *D. pentapotamiæ* from Indian Miocene beds.

In Dinotherium all the molars and premolars have two transverse crests excepting the first (posterior) premolar, and its deciduous predecessor, which have three cross-crests.

The genera of the Elephantidæ are the following :

I. Inferior incisors and premolars present.

Superior incisors with enamel-band........................ *Tetrabelodon* Cope.

II. Premolars, but normally no inferior incisors ;

Intermediate molars isomerous ; superior incisors with enamel-band.
Dibelodon Cope.

Intermediate molars isomerous superior incisors without enamel-band.
Mastodon Cuv.

Intermediate molars heteromerous; superior incisors without enamel-band.

Emmenodon Cope.[1]

III. No premolars, nor inferior incisors.

Intermediate molars heteromerous. Superior incisors without enamel-band.

Elephas Linn.

The characters assigned to the above genera are sufficient to separate them, but they have not come into general use for two reasons. One is the difficulty of verifying some of them, especially the presence of premolars, owing to the difficulty of obtaining specimens of young individuals. The other is the indisposition of naturalists to abandon the system of Falconer. As is well-known, this able paleontologist distinguished the genera by the number and depth of the transverse crests of the molar teeth, and the extent to which their interspaces are filled with cementum. This arrangement is insufficient, since it neglects the equally important characters above

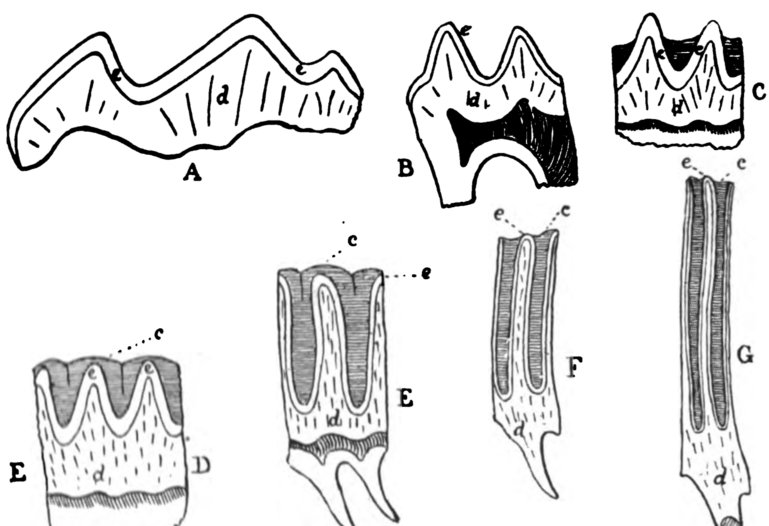
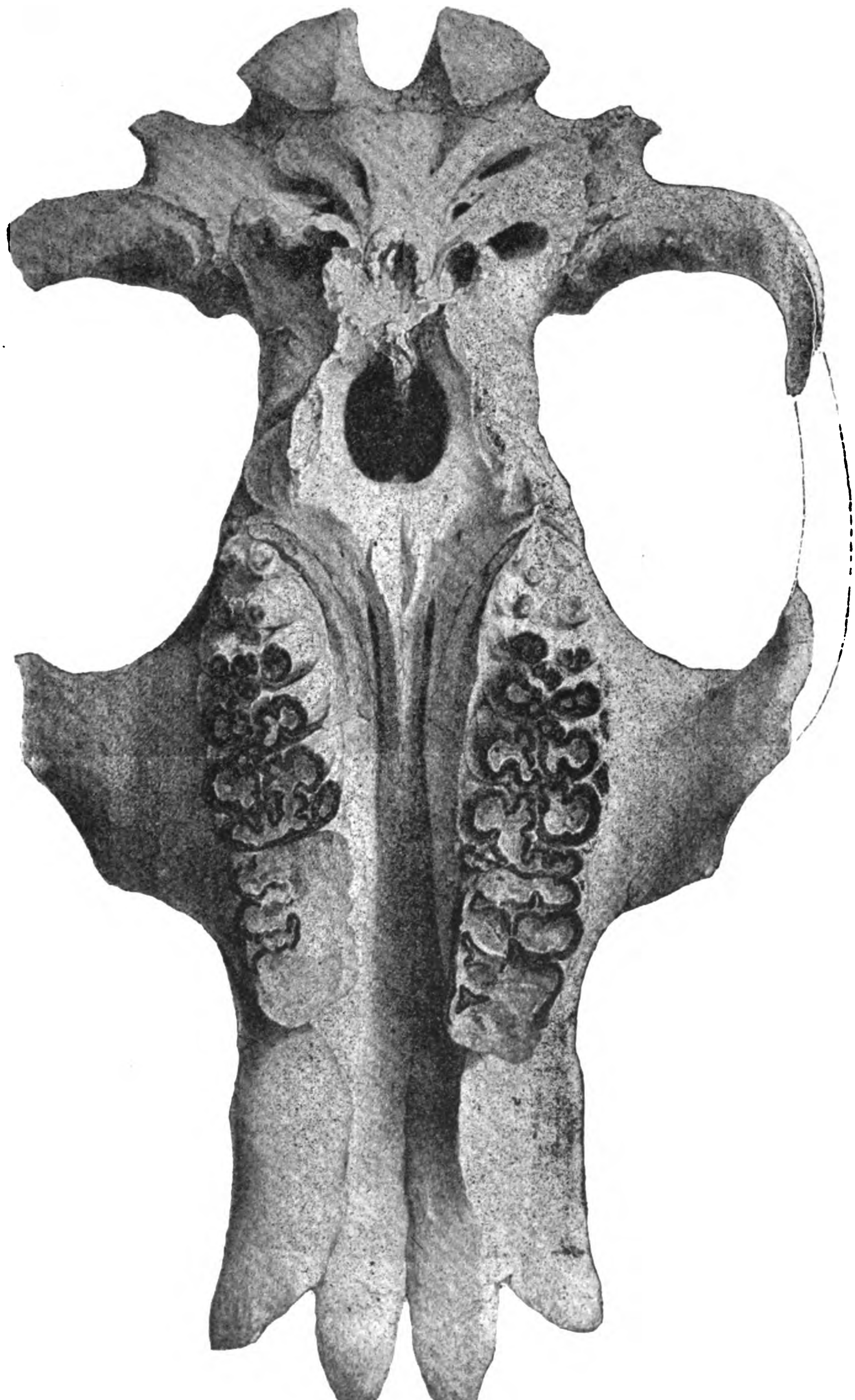


FIG. 3. Longitudinal sections of the molar teeth of Proboscidia, much reduced, from Gaudry. Letters; *c* cementum; *d* dentine; *e* enamel. A, Inferior molar of *Dinotherium giganteum* Cuv. B, superior molar of *Mastodon americanus* Cuv. C, lower molar of *Elephas ganesa* C. F. D, do. of *Elephas insignis* C. F. E, do. of *Emmenodon planifrons* C. F. F, do. of *Elephas hysudricus* C. F. G, do. of *Elephas indicus* L.

[1]Gen. nov. Type *Elephas cliftii* Falc. Cautl., *Mastodon elephantoides* Clift.

PLATE IX.



Tetrabelodon campester Cope.

mentioned; and as observed by Lydekker[1] it fails to furnish clear definitions. He remarks, under the head of the genus Elephas, "There is no character by which the present genus can be distinguished from Mastodon; and the division can be therefore only regarded as a matter of convenience." The characters presented in the above table are on the other hand very distinctive, and can be applied in all cases where we have the necessary information. This has not yet been obtained as regards all the species, and I have placed some of them in their respective genera provisionally. Such species are marked with an *i* when the condition of the incisors is unknown, and with a *p* when the same is true of the premolars. The species of the family described thus far, are as follows:

Tetrabelodon brevidens[2] Cope sp. nov. N. America *i. p.*
" *turicensis* Schinz. Europe.
" *angustidens* Cuv. Europe.
" " *palæindicus* Lyd. India.
" " *proavus* Cope. N. America.
" *productus* Cope. N. America, ? Mexico.
" *euhypodon* Cope. N. America *p.*
" *pandionis* Falc. Cautl. India.
" *pentelici* Gaudry.[4] Europe *p.*
" *campester* Cope. N. America. *p.*
" *longirostris* Kaup. Europe.
" *? serridens* Cope. Texas ?Mexico ?Florida.[5] *i. p.*
Dibelodon shepardi Leidy. California, Mexico. *p.*
" *cordillerarum*[6] Desm. South America.
" *tropicus* Cope. South America and Mexico. *p.*
" *humboldtii* Cuv. S. America.
Mastodon americanus Cuv.[7] N. America.
" *borsoni* Hays. *p.* Europe.
" *falconeri* Lydd. India. *p.*

[1]Catalogue of fossil Mammalia in the British Museum Pt. IV. p. 79.

[2]In compiling this list I have been greatly aided by the Memoirs of Lydekker in the Palæontologia Indica, and in the Catalogue of the British Museum.

[3]*M. proavus* Cope 1884 not 1873.

[4]According to Lydekker no premolars have been seen in this species.

[5]*M. ?floridanus* Leidy.

[6]*M. andium* Cuv. According to the recent researches of Burmeister, this species does not possess mandibular tusks. (Sitzungsb. Kön. Preuss. Akad. Wiss. Berlin 1888 p. 717.) Hence the specimens from Mexico with such tusks reported by Falconer, must be assigned elsewhere.

[7]This species is said by Lydekker not to possess premolars. Leidy Report U. S. Geol. Surv. Terrs. Pl., figures a tooth as a premolar, and similar specimens are not uncommon.

Mastodon *mirificus* Leidy. N. America. *i. p.*
" *sivalensis*[1] Cautley. India. *p.*
" *arvernensis* C. & J. Europe.
" *?punjabiensis* Lydd. India. *p.*
" *latidens* Clift. India.
Emmenodon elephantoides[2] Clift. India to Japan.
" *planifrons* Falc. Cautl. India.
Elephas bombifrons Falc. Cautl. India, ? China.
" *ganesa* Falc. Cautl. India.
" *insignis* Falc. Cautl. India to Japan.
" *meridionalis* Nesti. Middle and S. Europe, and N. Africa.
" *hysudricus* Falc. Cautl. India.
" *antiquus* Falc. Europe ? W. Africa.
" *mnaidriensis* Leith-Adams. Malta.
" *melitensis* Falc. Malta.
" *namadicus* Falc. Cautl. India to Japan.
" *primigenius columbi* Falc. W. N. America, Mexico.
" " *primigenius* Blum. N. Hemisphere.
" " *americanus* DeKay. E. N. America.

To these we must add the two existing species, *Elephas africanus* and *E. indicus*. Several species are not sufficiently known for reference to their proper genus. Such are *Mastodon perimensis* Falc.Cautl. India; *M. atticus* Wagn. S. Europe; *M. serridens* Cope, Texas; *M. cautleyi*, Lydd. India, and *M. obscurus* Leidy, N. America. In these the characters of both the incisor and premolar teeth are unknown. In some

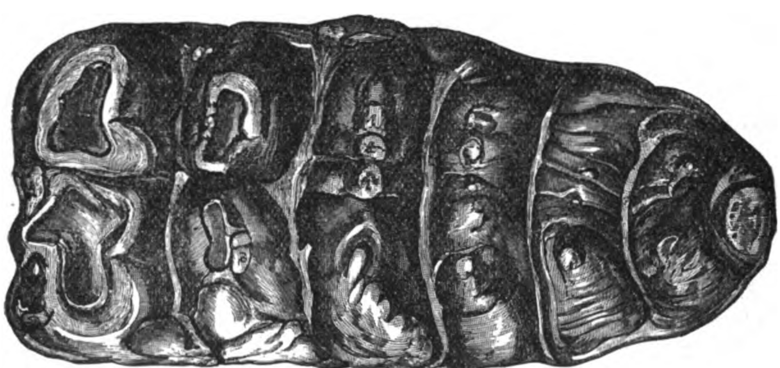


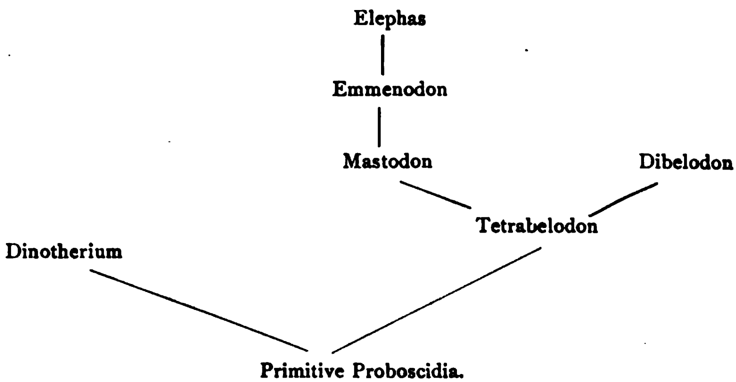
Fig. 4. *Mastodon latidens* Clift left sup. molar 3 from ? Pliocene of Borneo: two-thirds natural size. From Lydekker.

[1]According to Lydekker, premolars have not been observed.
[2]*Mastodon* Clift; *Stegodon* Falconer; *Elephas* Lydekker.

of the species referred above to Mastodon, mandibular tusks are present in the young, and occasionally one is retained to maturity, as sometimes seen in *M. americanus*. But such individuals are exceptional among their species. In some other species while the males possess them, they are wanting to the females. The specific character is in this case derived from the male.

The molar dentition in this family possesses a number of peculiarities which have been worked out mainly by Falconer, Owen, and Lydekker. There are probably deciduous molars in all the species, and they are generally three in number. The posterior of these has the same number of cross-crests as the posterior premolar, which immediately succeeds it. The number of crests diminishes to the first of the series. There are two or three premolars in most forms of the family, but in the genus Elephas they have disappeared. In all the species they are shed early in life in order to make way for the true molars. As the latter teeth are very large, and the fore and aft extent of the jaws is small, there is only space for one or two of them at a time. In most of the species the last molar so much exceeds the others in size, that it occupies the entire jaw, and the other molars are shed in order to accommodate it. In the genera Tetrabelodon, Dibelodon, and Mastodon, the last premolar, and the first and second true molars are isomerous, *i. e.* have the same number of cross-crests. In Emmenodon and Elephas they are heteromerous; that is, the number of cross-crests successively increases from front to rear. Thus in the three genera named the ridge formula is; P. M. 2—2—3; M. 3—3—4, and P. M. ?—? 4; M. 4—4—5 or 4—5—6. In Emmenodon the ridge formula is, P. M. ?—?—?—5; M. 6-7—6—7-8; and P. M. ?—6-7; M. 7—8-9—10-12. In Elephas the formula extends from M. 6—6-7—8-9, to M. 9-15—14-16—18-27. Each genus then has a certain range of variation in the number of molar crests, extending from a smaller to a larger number. This successive increase in complexity has been regarded by Falconer as the index to the successive evolution of the species, and rightly so. As already remarked; however, other measures of the same succession cannot be overlooked, especially as

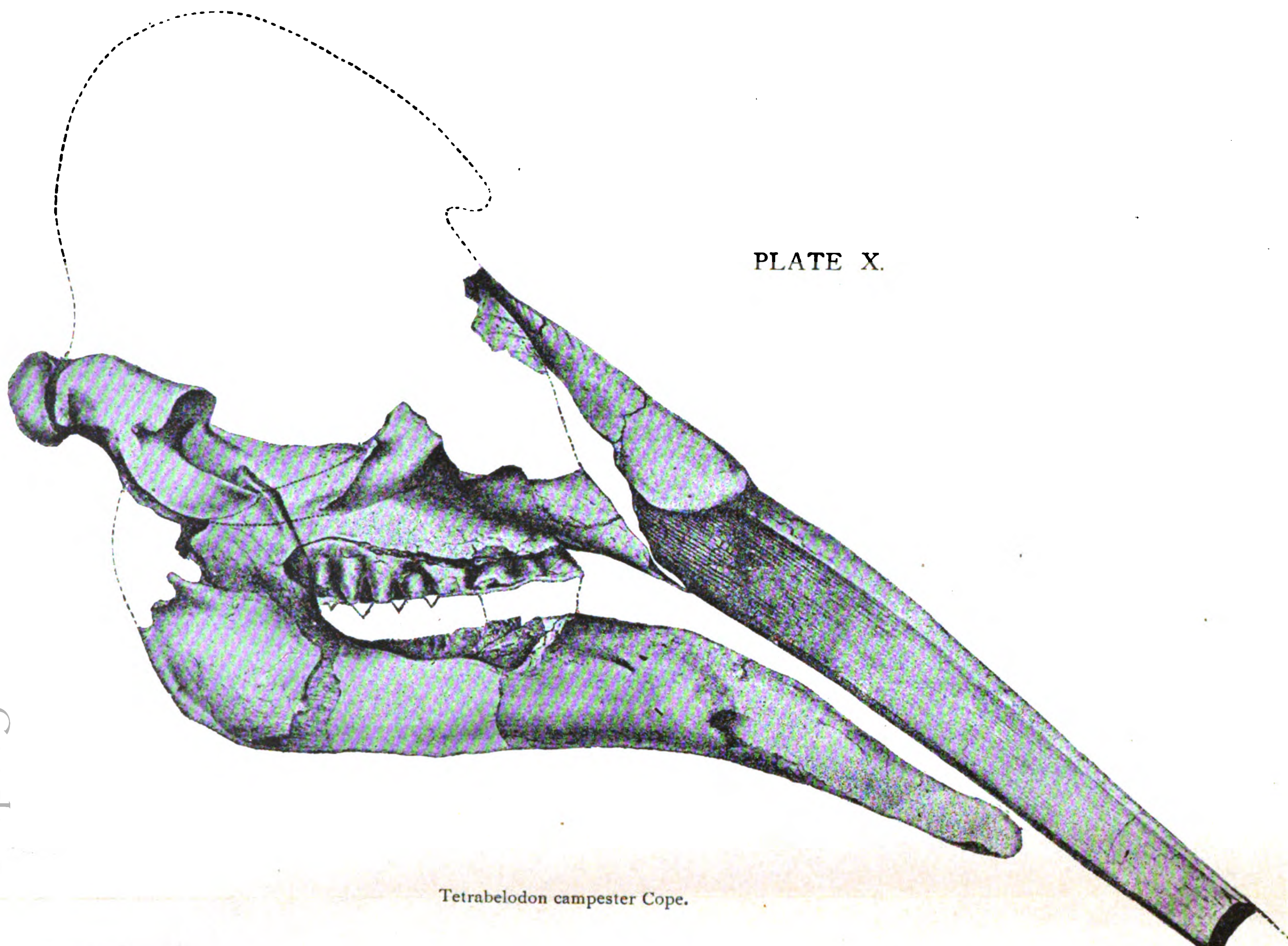
the ridge formula changes in so gradual a manner as to render it unavailable as a basis of exact divisions, as has been remarked already by Lydekker. It is evident that the primitive Proboscidia had incisor teeth in both jaws, and that these had more or less of the usual enamel investment. The gradual modification of these features is therefore another indication of the line of descent of these animals. The primitive Proboscidia had likewise four premolars, as is now seen in Dinotherium. The successive loss of these teeth is no less an index of the evolution of the modern types of the order, than the other modifications referred to. In general, then, the phylogeny of the order may be represented thus:



Within each genus certain parallel modifications of the composition of the crowns of the molar teeth may be observed. The cross-crests may be single, or they may be divided up into tubercles. The valleys between them may be open (1) or they may be blocked by (2) a system of single intermediate tubercles; (3) by numerous intermediate tubercles; or (4) by the thickening of the primary tubercles. I arrange the species according to these characters.

	Tetrabelodon.	Dibelodon.	Mastodon.
1	*T. ? brevidens.*		*M. americanus.*
	T. turicensis.		*M. borsoni.*
			M. latidens.
2	*T. angustidens.*	*D. shepardi.*	*M. ? cautleyi.*
	T. productus.	*D. cordillerarum.*	*M. falconeri.*
	T. serridens.	*D. tropicus.*	

PLATE X.



Tetrabelodon campester Cope.

	T. euhypodon.		*M. arvernensis.*
	T. longirostris.		
3	*T. campester.*	*D. humboldtii.*	*M. sivalensis.*
	T. pandionis.		*M. punjabiensis.*
4			*M. mirificus.*
			?M. atticus.

Parallels between the species of Emmenodon and Elephas also exist. As but two species of the former genus are known, we must look for future discoveries to increase the number of correspondences. The species of both genera which approach nearest to Mastodon have a smaller number of cross-crests, which are of lesser elevation, and whose intervening valleys are occupied by but a shallow deposit of cementum (fig. 3, C. D.) These are the Stegodons of Falconer; (1). In the other group, (2) the crests are numerous and elevated, and their interspaces are filled with cementum. (Fig. 3, E. F.)

	Emmenodon.	Elephas.
1	*E. elephantoides.*	*E. bombifrons.*
		E. ganesa.
		E. insignis.
2	*E. planifrons.*	*E. meridionalis.*
		E. hysudricus.
		E. antiquus. etc.

It is observable that each type of molar teeth of the three genera first compared, has representatives in the regions where their species occur; North America, Europe and India.

The North American species of this family are distinguished by the following characters of the molar teeth.[1]

I. Intermediate molars with not more than three crests; (trilophodont).

a. Crests acute, transverse.

β. Valleys uninterrupted.

Last superior molar with three crests and a heel; crests low, not serrate. *T. brevidens.*

Last superior molar with four crests and a heel; crests elevated, not serrate. *M. americanus.*

ββ. Valleys interrupted.

[1]From the AMERICAN NATURALIST. 1884. p. 524.

Edge of crest tuberculate..*T. serridens.*

aa. Crests transverse, composed of conic lobes.

β. Valleys little uninterrupted.

Last inferior molar narrow, with four crests; an accessory tubercle in each valley; *D. shepardi.*

β. Valleys interrupted.

Last inferior molar with four crests and a heel; symphysis short, M. 150; smaller size..*T. euhypodon.*

Last inferior molar with four crests and a cingulum; symphysis longer, M. .280; size medium..*T. productus.*

Last inferior molar with five crests and a heel; symphysis very long, M. .450; size largest..*T. angustidens.*

"*aaa.* Crests broken into conic lobes; those of opposite sides alternating.

Last inferior molar narrow, supporting four crests and a heel.......*T. obscurus.*"

II. Intermediate molars with four transverse crests; (tetralophodont).

A long symphysis; crests well separated, tubercular, with accessory lobes interrupting valleys..*T. campester.*

Symphysis very short; crests thick, closing valleys by contact; no accessory cusps; (Leidy)..*M. mirificus.*

III. Intermediate molars with 9–16 crests.

β. Valleys filled with cementum.

Last molar with 18–27 cross-crests; ....*Elephas primigenius.*

The stratigraphic position of these species is as follows:

Pleistocene.
- *Mastodon americanus.*
- *Elephas primigenius* (less abundant).

Pliocene.
- *Elephas primigenius* (more abundant).
- *Tetrabelodon serridens* (horizon probable).
- *Dibelodon shepardi.*

Upper Miocene (Loup Fork).
- *Tetrabelodon euhypodon.*
- " *productus.*
- " *angustidens.*
- " *campester.*
- *Mastodon mirificus.*

Ticholeptus bed.
- *Tetrabelodon brevidens.*

The horizons from which were obtained the *Tetrabelodon obscurus* Leidy and the *Dibelodon shepardi* Leidy, are not sufficiently well-known. In the valley of Mexico, the *D. shepardi* is from the Pliocene. No species of the order has been found below the Ticholeptus beds; a horizon about parallel

with that in which the order first appears in Europe. The statement of Marsh that the genus has been obtained in the lower White River beds is an error. (King, Survey 40th parallel, I p. 412.)

The *Tetrabelodon brevidens* Cope is the oldest North American species, and presents a very simple type of molar. The last superior has but three cross-crests and a heel, a smaller number than exists in any other species of the genus. The tooth is wide, and the crests are low. They are well divided in the middle by a fissure. Their edges are entire, but obtuse, and the first and second internal have a thickening at the base next the median fissure, which wears into a trefoil. These thickenings close the valleys at their base, but soon spread apart. They are absent from the third crest. The valleys are bounded on the inner side by a well defined ledge, which is represented by a rudiment on the external side. Enamel thick and smooth. Length of molar, 157 mm.; width at second crest, 98 mm.; elevation of second crest, 54 mm. This tooth resembles that of the *Mastodon americanus* more nearly than that of any other North American species, and is still more like that of the *M. borsoni* of Europe. The reduced number of its crests indicates it as the most primitive

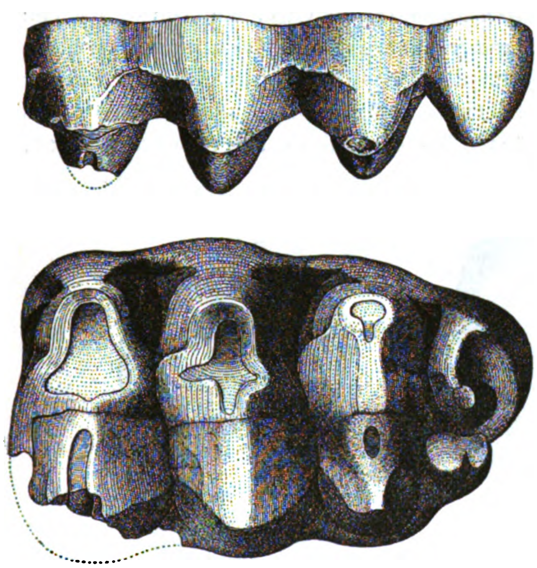


FIG. 5. *Tetrabelodon brevidens* Cope; last superior molar; from Ticholeptus bed of Montana. Four-ninths natural size. Original.

of the elephants, and as its horizon is the oldest, I have suspected that it had well developed incisor teeth in the lower jaw, and have, therefore, placed it provisionally in the genus Tetrabelodon. It is probably ancestral to the *M. americanus*, but, perhaps, not through American forms, since none with the same type of molar have been yet found in the formations which intervene between those in which the two species occur. Such forms occur in Europe, as the *Tetrabelodon turicensis* and the *Mastodon borsoni*. Unless some species of synchronous age with these is found in North America, we may suppose that the *Mastodon americanus* derived its immediate descent from Asiatic and European forms.

With the *Tetrabelodon angustidens* Cuv. we commence the series in which the transverse crests of the molars have the appearance of being composed of distinct but appressed conic tubercles. In most of them, the valleys are more or less interrupted by tubercles. This is one of the most abundant,

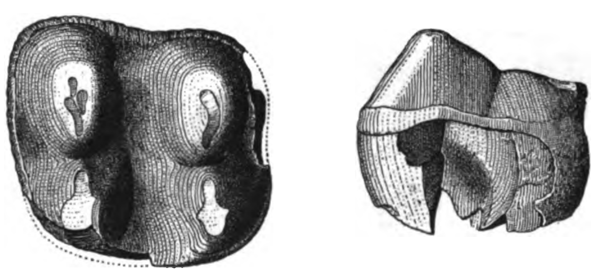
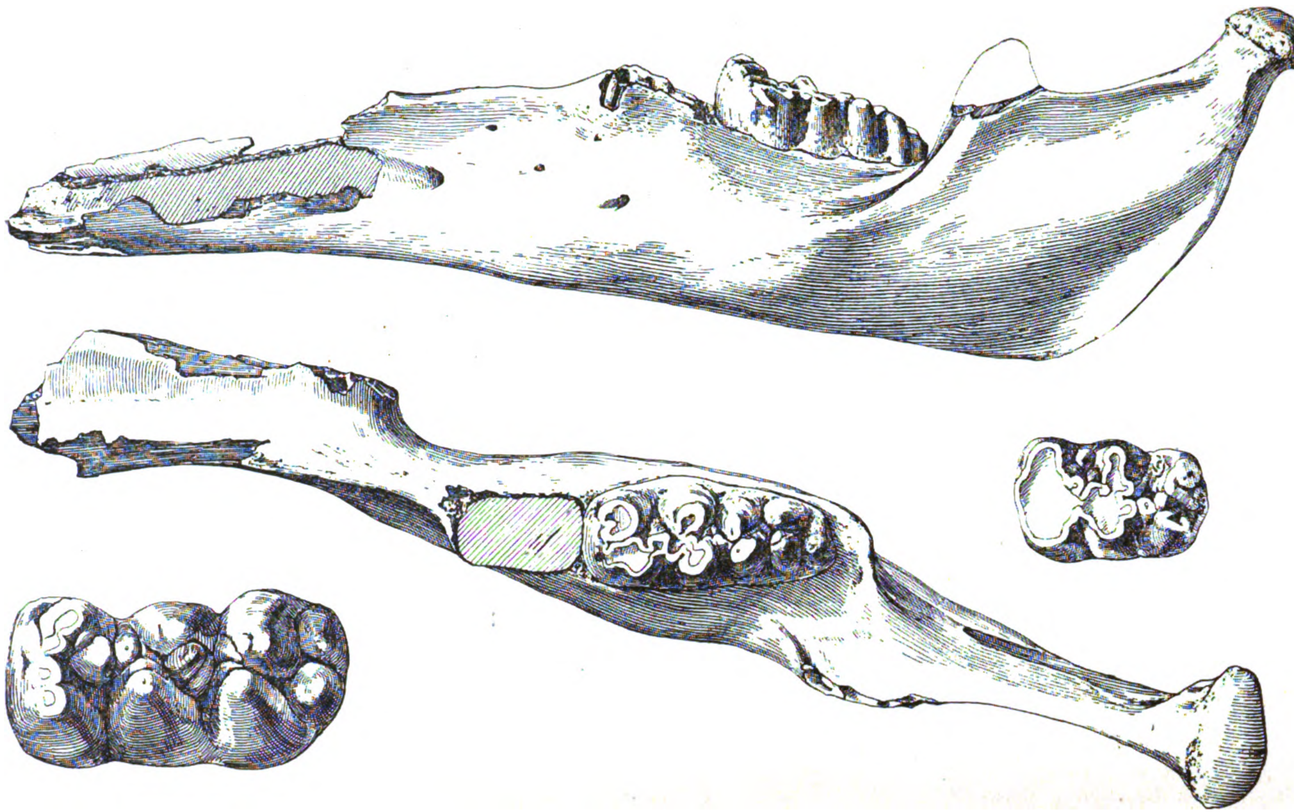


FIG. 6. *Tetrabelodon angustidens proavus* Cope; typical specimen from the Loup Fork bed of Colorado, two-thirds natural size. Original.

as well as the most widely distributed species of the family, extending its range from India to Central North America, through Europe. I have seen specimens from the Loup Fork beds of Kansas, Nebraska, and Dakota. Their size exceeds those of the typical European form, and the second (and probably third) true molars have a narrow fourth cross-crest. It is possible that it may become necessary, with more complete information, to distinguish this form as a species

PLATE XI.



Tétrabelodon proavus Cope.

under the name of *Tetrabelodon proavus*.[1] Probably, the same species has been recorded by Whitfield, from the phosphate beds of South Carolina, and compared with *M. obscurus*. The skeleton of the European form is represented in Plate XII. In a lower jaw in my possession, the left ramus measures m. 1.080 in length, of which .420 is symphysis.

The *Tetrabelodon euhypodon* Cope was founded on a nearly perfect left mandibular ramus with last molar tooth and tusk,

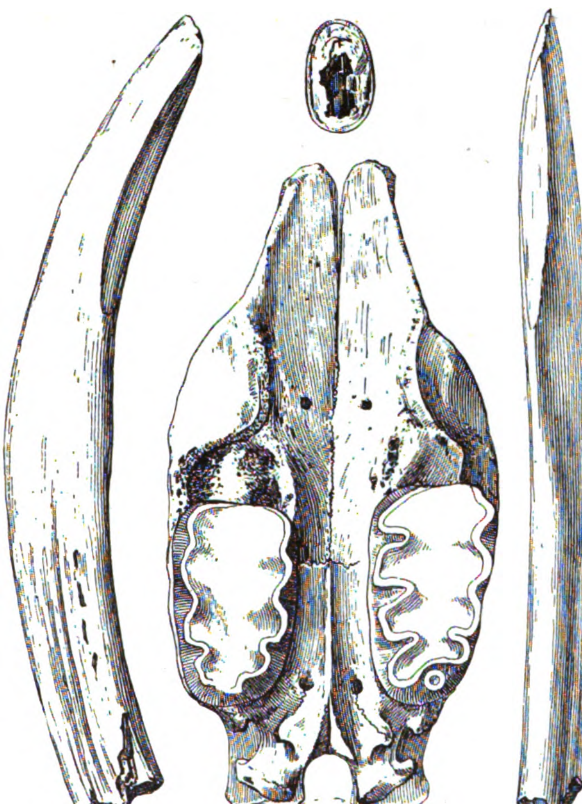


FIG. 7. *Tetrabelodon euhypodon* Cope; Loup Fork bed of Kansas. Palate with superior molars and superior incisors, of individual represented in Plate XIII; one-seventh natural size. Original.

[1] This species was originally represented by a penultimate milk molar, with two cross-crests, and the fragments of a probable last premolar. The former is about the size of that of the *M. angustidens*, but is more regularly quadrangular, and is composed of but four tubercles, united in pairs. (Fig. 6.)

with entire palate with both last molar teeth and tusks. The superior tusks are compressed distally, and the inferior tusks are large and have an enamel band; they are cylindric. The jaws indicate a smaller species, but the molar teeth are as large as those of the larger American form of *M. angustidens*, and as long as that of *M. americanus*, but narrower. Its symphysis is not prolonged, and the ramus is low and not compressed. Length of ramus posterior to symphysis, M. .500; of last lower molar, .182; width of do., 75. The mental tusk is much larger than that of *M. productus* or *M. angustidens*. Diameter of its alveolus, .068. There are several marked peculiarities in this species. The symphysis is remarkably short, when we consider the large size of the inferior tusks. The superior tusks are remarkably compressed for a considerable part of their length distally, having a vertically oval section. From the Loup Fork bed of Kansas.

Tetrabelodon productus Cope is abundant in the Loup Fork beds of New Mexico. It is a species of about the dimensions of the *T. angustidens* Cuv., but the symphysis is not so produced, and the ramus of the lower jaw is not compressed and elevated. It is the only species in which three superior premolars have been demonstrated; other species having generally two. The second and third true molars are in use at one time.

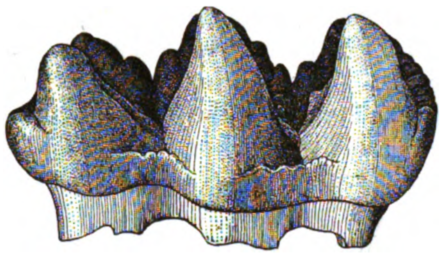
Tetrabelodon campester Cope is a rather large species, with a very long symphysis of the lower jaw, and a low ramus. The teeth are tetralophodont, and the sixth molar has six cross rows of tubercles and a heel. It is in some measure allied to the *T. longirostris* of Europe, but the symphysis is longer, and the teeth are more complex. The tusks are cylindric and nearly straight, and have a wide band of enamel. The known specimens are from the Loup Fork beds of Kansas and Nebraska. (Plates IX, X.)

The *Dibelodon shepardi* Leidy was founded on an inferior sixth molar tooth from California. I subsequently[1] described specimens of the same from the Pliocene bed of the valley of Mexico, where it was abundant. The molar teeth are rather

[1] "Proceed. Amer. Philosoph. Society," 1884, p. 5.

simple in construction, and resemble those of the *D. cordillerarum* Desm., but the species has a short, elephant-like symphysis.

The *Tetrabelodon serridens* Cope was founded on a first or



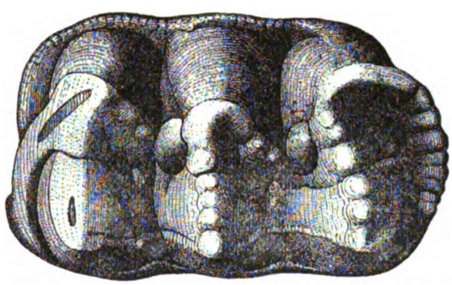


FIG. 8. *Tetrabelodon serridens* Cope; ?first molar. Typical specimen from ?Pliocene of Texas. Four-ninths natural size. Original.

second true molar from Texas. It is peculiar among American species in its acute elevated, entire crests, with tuberculo-serrate edges. It thus resembles the *M. turicensis*, but differs in well-developed longitudinal crests at the inner end of the external half of the crests, which consist of two tubercles on the posterior side of a crest, and one on the anterior side of the next succeeding crest. Strong anterior and posterior cingula ; edge of each cross-crest with six or seven tubercles. Length of crown, M. .130 ; width, .080 ; elevation, .061 Length of *M. americanus*, but narrower. Remains of a large Tetrabelodon from Florida have been described by Leidy under the name of *T. floridanus*. Its molars present

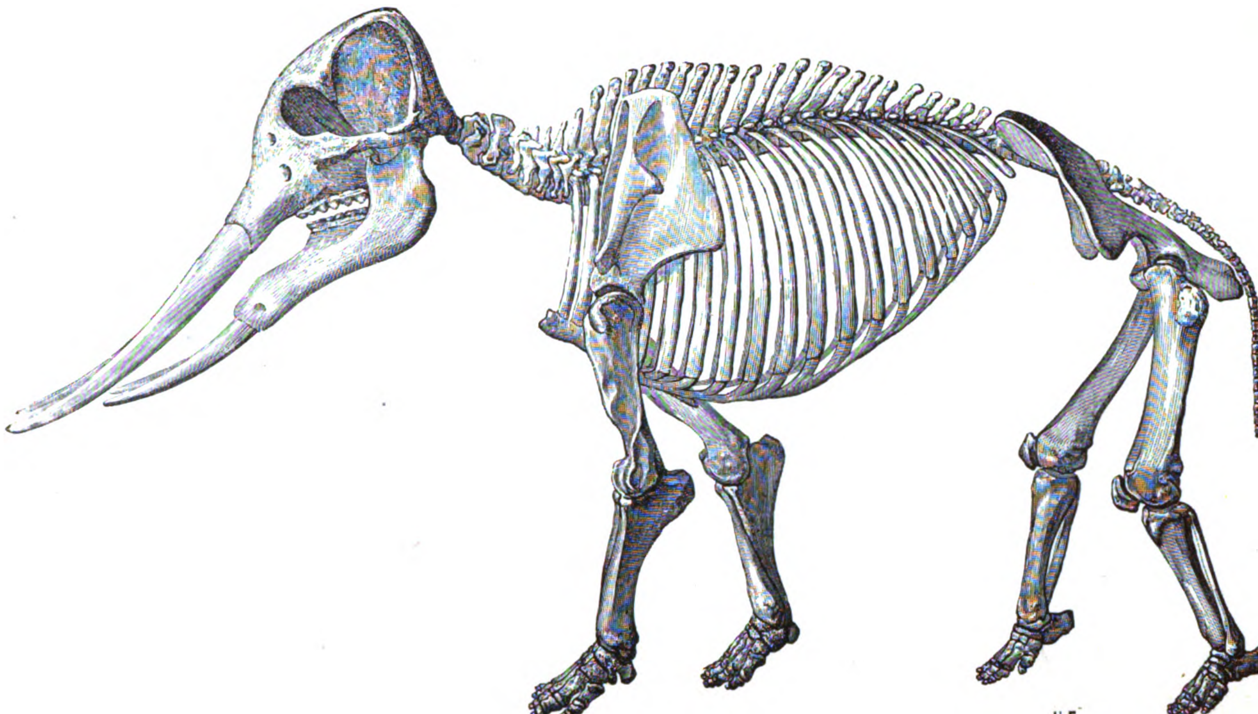
the tuberculated crests of the *T. serridens*, and no important characters appear to separate it from the latter.

The *Mastodon mirificus* Leidy is known from a left ramus of a lower jaw, which supports the last molar. The intermediate molars are probably four-crested (tetralophodont), and the last molar has six crests, and is a large tooth, occupying the entire dentary portion of the lower jaw. In this respect it differs from the *Tetrabelodons campester* and *longirostris*, where the fifth and sixth molars are in simultaneous use. The crests are divided on the middle line, and each half is so expanded as to close the intervening valleys very early in wear. Its symphysis is short and acute. Its nearest ally is the *M. atticus* Wagner, from the Upper Miocene beds of Pentelicus, Greece.

Mastodon americanus Cuv. is the best known and latest in time of the American elephants. It is one of the largest species, and, after *T. brevidens*, possesses the simplest molar dentition. The symphysis of the lower jaw is short and decurved. The skull is wider and less elevated than that of the mammoth, and the tusks are shorter and less recurved. It was very abundant during the Plistocene age throughout North America, from ocean to ocean, and as far south as Mexico; but it has not been found in the latter country. Its remains are usually found in swamps, in company with recent species of Mammalia, and with *Equus fraternus* and *Bos latifrons*. The carbonaceous remains of its vegetable food have been found between its ribs, showing that, like the mammoth, it lived on the twigs and leaves of trees.

It is at first sight curious that this, the simplest of the family of elephants in the characters of its molar teeth, appears latest in time on this continent. But it must be regarded as an immigrant from the Old World, where an appropriate genealogy may be traced. Its nearest ally, *Mastodon borsonii*, existed just anterior to it, during the Middle and Upper Pliocene, and this species was preceded in turn in the Middle and Upper Miocene by the *T. turicensis*, which possesses the same simplicity of the molar teeth. In its mandibular tusks the latter possesses another primitive character, which was nearly lost by its North American descendant.

PLATE XII.



Tetrabelodon augustidens Cuv. From Gaudry.

An ingeniously constructed fraud, consisting of parts of molar teeth of this species fastened together by cement, which was treated with wax, so as to resemble enamel, was described by me as representing a distinct species of this order, under the name of *Cænobasileus tremontigerus*.[1] The specimen was manufactured in southwestern Texas.

Elephas primigenius Blumenbach, the mammoth, was at one time distributed throughout North America, as far south as the valley of Mexico, inclusive. Its remains are found in the Upper Pliocene of Oregon, and in the Pliocene of Mexico, unaccompanied by the *Mastodon americanus*, which had not appeared by that time. In the Eastern States its remains occur with those of the *Mastodon americanus* at the Big Bone Lick, in Kentucky. It was not found in the Port Kennedy, Pennsylvania, Bone-fissure, although the Mastodon was there. This absence may have been accidental. Says Leidy[2]: "The animal (*Elephas primigenius americanus*) was probably of earlier origin, and became earlier extinct than the latter," an opinion which my own observations confirm. Since no earlier species of elephant proper is known from North or South America, we must regard this one as an immigrant from Asia, where, indeed, its remains abound. It remained longer in Siberia than in North America, since whole carcasses have been discovered imprisoned in the ice, near the mouth of the Lena River. These specimens had a covering of long hair, with an under hair of close wool.

Leidy and Falconer have observed that the teeth of the elephants from Eastern North America can be easily distinguished from those of the Mammoth by the greater attenuation of the enamel plates. Leidy also observes that the lower jaw is more acuminate in the former. He proposed, therefore, to distinguish it as a species, using Dekay's name, *E. americanus*. Teeth from Escholtz Bay, Alaska, he regards as belonging to the true *E. primigenius*.

Falconer regarded the true elephant of Texas as a distinct species, which he named *E. columbi*. He distinguished it by the coarse plates of the enamel, and by the wide lower jaw,

[1] "Proceedings American Philos. Society," 1877, p. 584.
[2] "Extinct Mammalia of Dakota and Nebraska," p. 398.

with curved rami, and short symphysis. So far as the dentition goes, I have specimens of this type from Colorado and from Oregon. The Oregon specimen presents the same type of lower jaw as does one from Texas, in my possession. Specimens from the valley of Mexico are abundant in the museums of the City of Mexico, and their characters do not differ

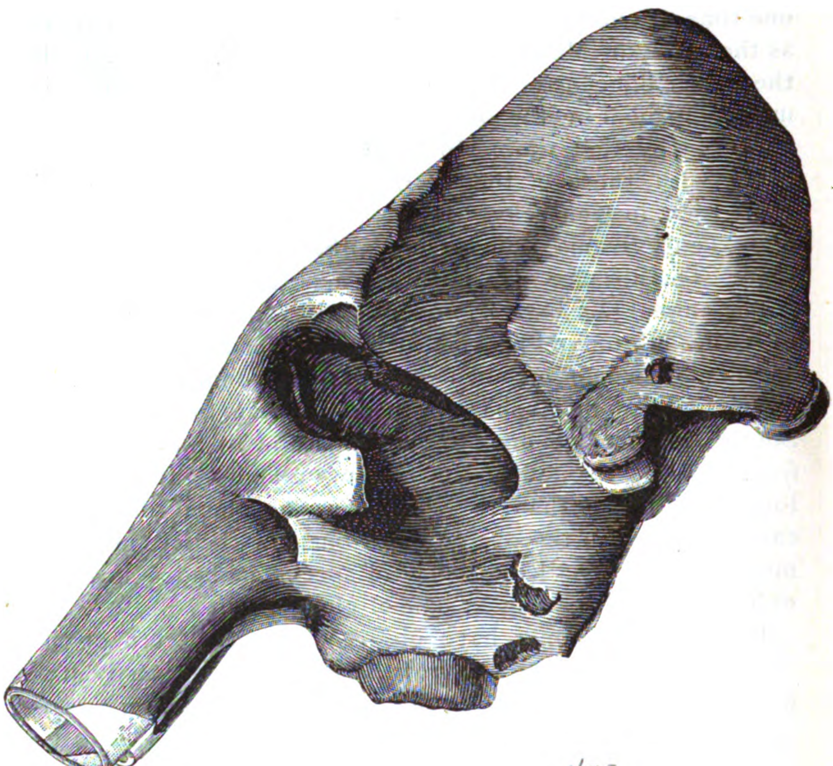


FIG. 9. ***Elephas primigenius columbi*** **Falc., from Texas, 1/7.7 Natural size. Original. Profile of skull represented in Plate XIV.**

from those from Texas. I have in my museum an entire skull, lacking the lower jaw, (Plate XIV.), from the "orange sand" of the city of Dallas, in Northeastern Texas, which only differs in form from that of the *E. primigenius*, as figured by Blumenbach and Cuvier, in the shorter and wider premaxillary region. This is one-half wider than long (from the molar alveolus)

while in the Ilford Mammoth in the British Museum, figured by Leith Adams,[1] the length of this region equals the width. The skull agrees with those of the *E. primigenius*, and differs from those of the *E. indicus* in the narrower proportions of the posterior part of the cranium. The teeth are of the coarse-plated *E. columbi* type. The individual is not very large, though old. The diameter of the tusks at the alveolus is 110 mm. In a fragment of a huge specimen from South-western Texas, the diameter of the tusk at the base is 210 mm.

As a result, it is not clear that the two American forms can be distinguished as yet from the *Elephas primigenius* or from each other, except as probable subspecies, *E. p. columbi*, and *E. p. americanus*. But more perfect material than we now possess may yet enable us to distinguish one or both of these more satisfactorily. No American species of the family exceeded this one in general dimensions, especially the form *E. p. columbi.*

EXPLANATION OF PLATES.

PLATE IX.

Tetrabelodon campester Cope. Palate with teeth from below, one-fourth natural size; from Loup Fork bed of Kansas. Original.

PLATE X.

Side view of jaws of individual of *Tetrabelodon campester* represented in Plate IX., one-eighth natural size.

PLATE XI.

Tetrabelodon angustidens proavus Cope, mandibular ramus and symphysis from above and in profile, one-sixth natural size. Fig. A, first true inferior molar of a young animal, one-third natural size. Fig. B, last superior premolar of young, perhaps of this species, two-fifths natural size.

[1] "Memoirs of the the Palæontographical Society," 1879, p. 69. Monograph of the British Fossil Elephants Pl. VI., VII.

Plate XII.

Tetrabelodon angustidens Cuv. Entire skeleton 1-26 natural size, restored by Gaudry. From the Miocene of France. From Gaudry "Enchainements du Régne Animal."

Plate XIII.

Tetrabelodon euhypodon Cope, mandibular ramus from above and in profile, one-eighth natural size. From the Loup Fork bed of Kansas. Original.

Plate XIV.

Elephas primigenius columbi Falc. Cranium. From Plistocene of Texas, 1-7.7 natural size. Original in Mus. E. D. Cope. The white spaces are light-colored bone, except at ends of premaxillaries, which are plaster.

Plate XV.

Outlines of crania of Proboscidia, much reduced; from Falconer; front views.

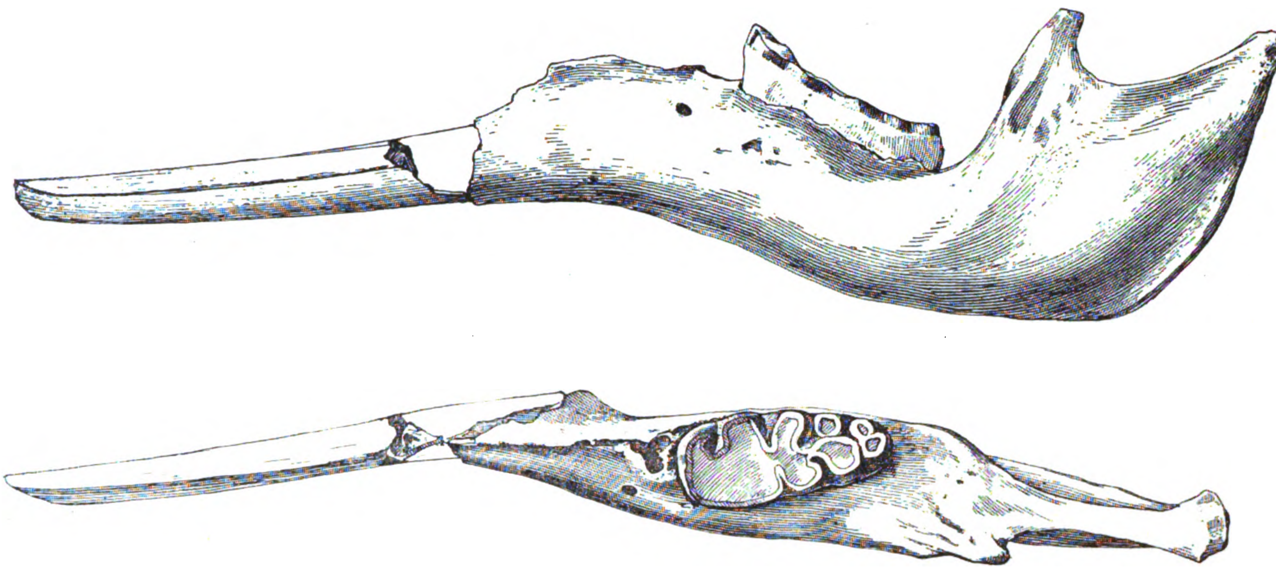
Fig. 1, *Dinotherium giganteum.* Fig. 2, *Mastodon americanus.* Fig. 3, *Dibelodon cordillerarum.* Fig. 4, *Mastodon perimensis.* Fig. 5, *Mastodon sivalensis.* Fig. 6, *Elephas bombifrons.* Fig. 7, *Elephas ganesa.* Fig. 8, *Elephas insignis,* including *a* and *b*, very young. Fig. 9, *Emmenodon planifrons.* Fig. 10, *Elephas africanus.* Fig. 11, *Elephas meridionalis.* Fig. 12, *Elephas hysudricus.* Fig. 13, *Elephas namadicus.* Fig. 14, *Elephas indicus,* including *a*, var. *mukna,* and *b*, young. Fig. 15, *Elephas primigenius,* after Fischer.

Plate XVI.

Outlines of crania of Proboscidia, much reduced; from Falconer; profiles.

Fig. 1, *Dinotherium giganteum,* from Kaup. Fig. 2, *Mastodon americanus.* Fig. 3, *Tetrabelodon angustidens,* after De Blainville. Fig. 4, *Dibelodon cordillerarum.* Fig. 5, *Mastodon perimensis.* Fig. 6, *Mastodon sivalensis.* Fig. 7, *Mastodon arvernensis,* from Nesti. Fig. 8, *Tetrabelodon longirostris,*

PLATE XIII.



Tetrabelodon euhypodon Cope.

after Kaup. Fig. 9, *Mastodon latidens.* Fig. 10, *Emmenodon elephantoides.* Fig. 11, *Elephas bombifrons.* Fig. 12, *Elephas ganesa.* Fig. 13, *Elephas insignis.* Fig. 14, *Emmenodon planifrons.* Fig. 15, *Elephas africanus.* Fig. 16, *Elephas meridionalis.* Fig. 17, *Elephas hysudricus.* Fig. 18, *Elephas namadicus.* Fig. 19, *Elephas indicus.* Fig. 20, *Elephas primigenius.*

ACROSS THE SANTA BARBARA CHANNEL.

BY J. WALTER FEWKES.

THE island of Santa Cruz, from the Mission Church of Santa Barbara, looks not unlike Capri, from the City of Naples. The same blue sky arches over it, the same Mediterranean haze envelops it, its outlines are softened by its distance, and its cliffs rise equally precipitantly from the sea. In my tarry at Santa Barbara, in the spring of 1887, I had repeatedly turned my eyes seaward, across the channel, longing for the opportunity, which at last came, to cross the intervening waters, and set foot on this island. My trip across the channel was productive of both pleasure and profit, and may not be without interest to my readers.

Although a comparatively narrow channel separates the Santa Barbara islands from the mainland, the means of communication are not always at hand. The enterprising fisherman, Larco, often crosses it in his Italian sailboat, the "Genova," but his accommodations for passengers are more or less limited. The vessel owned by the proprietors of the island was not at my disposal, and the only thing left was to charter a craft for my own use. Fortunately, it was possible to find such a vessel, and I was able to visit the nearest of the Santa Barbara islands, long ago discovered by Cabrillo, upon which, according to some authorities, he was buried.[1]

[1] Other historians say this intrepid discoverer found his grave at a neighboring island of San Miguel. Certain it is that he was the first European to sail up the Santa Barbara Channel, and that he lost his life on this voyage. His grave, wherever it may be, is not yet marked by monument or commemorative stone.

The "Angel Dolly," which is at anchor off the wharf at Santa Barbara, was found to be admirably suited for my trip, and after a few preparations, I embarked on her, and hoisting her sails, we turned her southward to the rocky cliffs of the island of the Holy Cross. The "Angel Dolly" is a small schooner of about twenty tons burden, with a cabin, which the passengers share with the captain, a forecastle for the crew, and a capacious hold. The crew consisted of a captain, one man before the mast, and a cook. The cabin I found well suited for my scientific work, and I transformed it into a laboratory, the mess table serving well for microscopic work when the vessel was on an even keel. My dredge, ropes, and nets were well stored in the hold, and at noon, in the middle of March, we hove anchor, set her sail, and went to sea. It had been my intention to visit the island of San Miguel, but the wind was so light that we shaped our course directly to Santa Cruz.

The weather, when we left Santa Barbara, was foggy, and after getting outside the zone of giant kelp,[1] we were becalmed. As a result we drifted back and forth all the afternoon, and finally found ourselves down the coast towards Carpenteria, the storehouse and wharf of which place we saw a few miles away, at nightfall. Although the distance across the channel is about twenty-eight miles, we made little progress that night, and drifted about in the fog until Sunday morning. After many calms, puffs of air, and baffling winds, we sighted, Sunday morning at ten o'clock, the lofty peak of Punta del Diablo, the most lofty headland on the island of Santa Cruz. We ran in toward the land, through the fog, to the neighborhood of the shore, and anchored in a small fiord at the base of Monte Diablo. This fiord, which we will call Star Cañon, is enclosed by lofty cliffs many hundred feet high. As we sailed into it, I saw, for the first time on the Pacific ocean, a large Salpa, which rivals the *Salpa maxima* of the Mediterranean, a floating Ascidian, the "solitary

[1] This zone forms a curious belt, skirting the shore at Santa Barbara. It is composed of the floating fronds of a giant alga (*Nereocystes*), and is situated about three hundred yards from the shore. This zone imparts a highly characteristic appearance to the coast of many parts of Southern California.

form" of which is as large as a man's hand, and the "chain form" is many yards in length.

Looking into the cañon[1] from our anchorage, we notice that the high cliffs of the brow, which appears an unbroken peak from Santa Barbara, have a cleft form with jagged edges, as if they had been broken asunder by volcanic forces. This effect is thought to be due to the recent elevation of the island, and to tell the same story as the raised terraces on the eastern and western ends of the island. In the chart, by the Coast Survey, a mountain called Ragged Mountain occupies the position of this break. The mode of formation of this cañon and fiord[2] is not wholly clear to me. That water has played an important part in its formation is doubtless true, but, at the same time, the sharp break indicates some other and more violent geologic agency. The perpendicular walls of the cañon are certainly from 600 to 900 feet high. The cañon makes up through the mountains, and in the present season a good stream of fresh water flows out of it past the shingly beach to the cove. On the mountain side we noticed little vegetation, but here and there a clump of prickly pears, and small bushes with yellow poppy flowers. The rock is a coarse conglomerate, the embedded boulders of black asphaltic color, and the matrix red. The matrix is in many places very much eroded, and the hard, embedded, angular rocks stand out in relief, sometimes clinging to the cliff by a single edge. The embedded rocks are angular, and little water-worn, except where they are exposed to wave action.

[1] This fiord is almost directly opposite Santa Barbara, under the high peak, which appears from this city to be the apex, or highest point of the island. Its name is not given on the excellent chart of the island, which I made use of on my trip.

[2] From my work with the dredge I am led to believe that these chasms in the islands which are called cañons extend for some distance under the water. I have found records that the officers of the Coast Survey have made similar observations. If such a submarine continuation of these cañons occur, it is difficult to explain them as wholly the result of erosion, or if of aerial erosion, the islands may have sunk subsequent to this action. The evidence on the west end of the island points to elevation, or in this way the elevated terraces were interpreted.

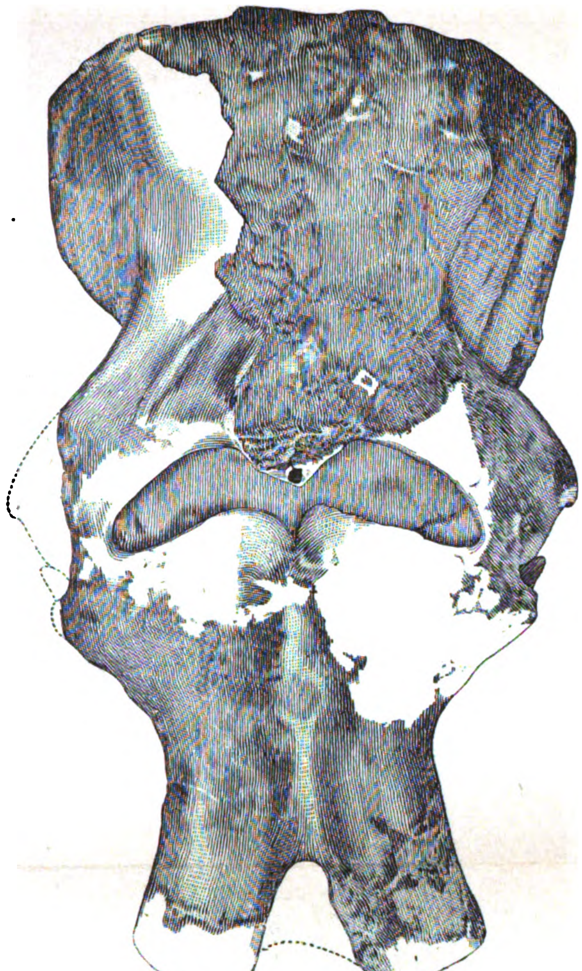
Some of the neighboring islands like Anacapa, show similar elevation, with enormous denudation. The form of this island from the sea is highly suggestive, but I was unable to land upon it.

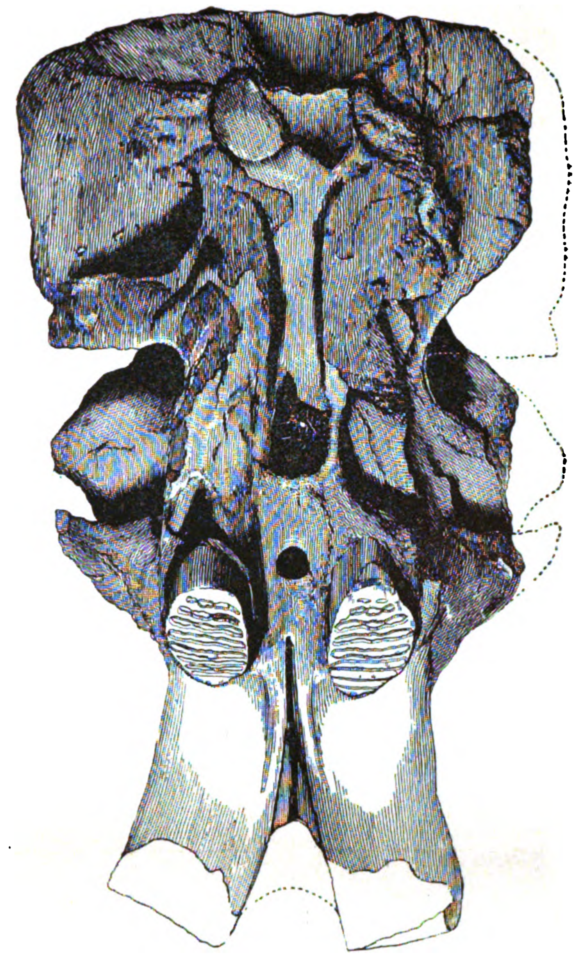
The fiord in which the "Angel Dolly" rides at anchor is well protected from the prevalent gales, and the water, although deep, is easily sounded by our anchor. We anchored near the shore, not far from the beach, at the end of the cañon. After all had been made snug aboard, we rowed to the shore, and took a stroll up the cañon, following the bed of the brook. The cañon is well wooded with many kinds of trees, and with ferns and mosses, with here and there, wild flowers. As we landed on the shore we started up two small, wild foxes, *Urocyon littoralis*, so abundant on the island, and came within easy gunshot of them.

On each side of the cañon the cliffs rise precipitantly, almost perpendicularly, so that it is impossible to climb them, and it is with great difficulty that we made our way along their base. Many large boulders lie strewn along the bed of the stream, and there are many deep basins of pure, fresh water, fed by the sparkling mountain stream from the cañon. In one or two places the bed of the stream is dry, the water having made a channel for itself through passages under the rock or soil. At certain places these dry sections of the bed of the stream are coated with a white deposit. There were many cottonwood trees as far up the cañon as we were able to penetrate. Near the beach we noticed the remains of an old camp-fire, and the skins of two sheep, which told the story of a former camping party, probably of fishermen, visitors to this lonely and picturesque place. There are also many abalone shells (*Haliotis*), the animals of which had also, no doubt. formed part of the meal of these visitors.

The level deposit of soil at the mouth of the cañon must have been a favorite camping place for the Indians who once lived in great numbers on this and neighboring islands, for on the side hill there is a high shell heap where they had thrown the debris of their camp. This shell heap was formed in great part of the shells of a large Balanus, Haliotis, and Mussels. On the sides of the rocks above it many Indian inscriptions were cut in the hard rocks of the conglomerate. These inscriptions were made with some care and consist of parallel grooves in the rock across which, at right angles, were other grooves all of undoubted Indian origin. We returned to the

PLATE XIV.





"Angel Dolly" and transported our cooking utensils on shore preparatory to a camp there under the brow of the cliffs of the cañon.

In the afternoon I took a sailor and one of the seal boats of the schooner and rowed down the shore to the westward under Punta del Diablo to the "Seal Rookery." This boat ride was the most wonderful trip which I have ever taken on the coast of California. The cliffs to the west of Star Cañon rise perpendicularly to the height of many hundred feet, so that it is impossible to climb them except in the small fiords or cañons which extend into the mountains. Immediately after rounding the high headland to the west of Star Cañon we come to the first cañon, which is well wooded and surrounded by mountains which are grandly picturesque. We did not land in this fiord but continued to the second, which was even more rugged and abrupt than the first. This cañon presented to us a landing place, and we rowed through the heavy surf, landing on a small beach. The cañon is well wooded but closed a short distance from the beach by a high boulder, which has fallen into it, so that the cañon is almost blocked up. The boulders, which stop up several of the cañons, are thought to have been eroded from the cliff in the position they at present occupy, and not to have been transported from higher up the cañon by water or ice.[1]

We made our way back of the boulder through a crevice between it and the cliff and continued up the cañon a few hundred yards, but the way gets more difficult, the loose

[1]Something analogous to this is to be seen in the boulders of red sandstone which are strewn along on the mesa at the foot of the Santa Inez mountains back of Santa Barbara. These rocks are sometimes of great size and, according to Whitney, were washed down from the mountains which everywhere show signs of great erosion. They become very thickly massed together in some places and often reach enormous proportions. I was unable to find glacial striæ on the sides of the Santa Yeury range although I repeatedly looked for them.

One of the most famous of these large erratic rocks is that near Montecito which bears the Indian inscription done in red paint. Beyond the Mission Church they are very numerous in some places blocking up the cañons as in the island of Santa Cruz. In some places they are so numerous that they almost form boulder rivers. Just back of the Spanish part of Santa Barbara between the city and the mesa there are many eroded valleys and as we pass over the mesa to the foot of the Santa Yeury range the erratic rocks increase in size and number.

rocks more numerous and the walls of the cañon more and more precipitant. The same conglomerate is present here as at Star Cañon, near which our schooner is anchored.

I made a sketch of the place and took again to boat passing under the brow of Punta del Diablo, one of the grandest points of the island.

Under the base of Diablo opens "Devil's Cañon" or "Devil's Cove," a most picturesque, wild and rugged combination of land and sea. In this part of Santa Cruz there are no beaches and no zone of kelp, but the water sinks to a great depth hard by the shore, and dredging was impossible with the implements at my disposal. At the base of Punta del Diablo there are two conical elevations rising as islands out of the sea. These elevations when approached from the east appear perfectly symmetrical, the more distant from the point being capped by an eagle's high nest. The hills are green to their summits.

Near these conical islands we rowed into a grotto of wonderful beauty. It extends deep under the mountain and as our boat made its way in, we saw many seals and sea-lions on the ledges of the rock. As we rowed in, these huge animals dove into the sea with hoarse barking and swam into the depths of the cave. We fired at them with our rifles and the reverberation was something deafening. In the cave, which extended many feet beyond, a tremendous sea was rushing at every incoming wave. The whole grotto reminded me of the famous grotto of Capri in the Bay of Naples.

Beyond Punta del Diablo the cliffs take the form of a gigantic saw, the top of the precipices being worn out into valleys which are symmetrical one after another. Beneath these saw-like valleys the rock shows much erosion especially near the level of the sea At one place a perfectly formed human figure which appears to be in the act of stepping into the sea, can be made out. A tremendous surf breaks on the base of the cliffs and here and there where there are partially submarine grottos or caves the escaping air throws the water to great heights with a loud noise.[1] Behind us the monster

[1]These spouts of water thrown into the air by the resistance of the air compressed in a half submarine grotto by an incoming wave are among the most interesting.

cliff of Punta del Diablo extends almost perpendicularly out of the water. The view of the coast looking both east and west is perfectly grand. Away to the west we sight the conical rocks and islands which form the eastern side of the "Seal Rookery."

As we row along we see here and there on the sides of the cañons a few sheep and one or two wild hogs. The east side of the Seal Rookery is bounded by islands with natural arches and lofty cliffs. Off these islands a short distance there is a small island with a flat top, and near it are two beautiful natural arches. The flat rock is white with guano, and the natural arches are high enough to allow a boat to pass under them. There is no landing place of any size at the Rookery, but vast numbers of seal are seen basking in the sun. Here we see much kelp, and for the most part the coast everywhere is bold and rugged. At the Seal Rookery we turn back towards Star Cañon and after a hard pull we came at last to the smooth water in which the schooner is at anchor.

One of the most beautiful of all the cañons which we passed was Lady's Cañon, a most picturesque place with smooth water and cliffs rising on all sides. The scenery here is very grand. Floating kelp was found at several places and one or two gigantic floats of the "Sea-Onion" were found, but as a general thing the coast is bare and no zone of kelp like that of Santa Barbara was seen.

phenomena of the coast. Their height is often very considerable and the noise with which the water is forced out is often very great. The surf upon the base of the cliffs is often very heavy after the sudden winds which often arise without a moment's warning.

The sudden and local character of the gusts of wind is in some cases due to the cañon configuration of the coast. A most marked instance illustrative of this explanation was experienced in my approach a few weeks later to the harbor of Port Harford the port of San Luis Obispo. We had steamed along the whole afternoon over a tranquil sea without a ripple when suddenly on our approach to this port there came down a violent gust of wind out of the cañon such that the steamer seemed to pass immediately into a raging tempest which as suddenly ceased when we drew up at the wharf.

(To be continued.)

THE POLAR DIFFERENTIATION OF VOLVOX, AND THE SPECIALIZATION OF POSSIBLE ANTERIOR SENSE-ORGANS.

BY JOHN A. RYDER.

IN a recent communication upon this subject which the writer made to the Academy of Natural Sciences of Philadelphia, the fact was pointed out that in *Volvox minor* there are very distinctly differentiated anterior and posterior poles or hemispheres. The anterior or empty pole is so named here because it is the one which is always directed forwards when the animal is in motion. The posterior pole is so named because it is always in a posterior position when the organism is moving freely and normally, and it is further distinguished from the anterior in that it is in this hemisphere, in *V. minor* at least, in which the germs are produced which give rise to young Volvoces. Roughly speaking the nearly spherical cænobium or colony of Volvox may be divided into an anterior and a posterior hemisphere. Through the centres of these hemispheres there passes an imaginary axis around which the colony rotates in either a sinistral or dextral direction, but progressive locomotion is always in the direction of the anterior empty pole of the cænobium. This differentiation of the poles of the colonies of Volvox appears to have been known to Ehrenberg, who figures them but makes no farther mention of the fact. Hicks is reported in the *Midland Naturalist*, 1880, to have observed that the young leave the parent cænobium by breaking through the wall of the hinder or spore-bearing hemisphere, a fact which I can confirm.

While these facts have been partially recorded by previous observers, there is another group of facts which I have noticed which are far more important and remarkable and serve to establish beyond question the polar differentiation of Volvox, and also raise the suspicion that this animal or plant, whichever it is, is endowed with a very primitive sensory apparatus which is developed to an importance anteriorly, eight or ten times as great as at the posterior pole. It is well known that

each one of the biflagellate cells of Volvox contain superficially embedded a reddish lenticular refringent body known since Ehrenberg's time as "eyes" or "eye spots." One of these "eye spots" lies not very far from the base of one of the flagella in each cell, and produces a slight rounded projection of the thin layer of clear protoplasm immediately overlying and surrounding it. In optic section these reddish bodies are seen to be lenticular or nearly so, the outer face being less convex than the inner. This is best seen in the "eye-spots" of the anterior pole. These "eye-spots" strange to say, bear a constant and definite relation to both the imaginary axis around which the colony revolves and the flagella of its cells. They are placed not quite on the extreme outer periphery of the cells as reckoned from the centre of the globular colony, but nearly so. The anterior ones at the anterior pole consequently look forward, while the others of the rest of the cells look in all other directions, the hindmost ones looking directly backward.

Now comes the most singular and interesting fact which I have observed, viz: *that the "eye-spots" of the cells of the anterior pole are eight to ten times as large as those of the hinder pole.* The passage from the large "eye-spots" of the anterior pole to the smaller ones of the posterior pole is very gradual, as can be readily observed with a moderately high power. These "eye-spots" diminish so much in size on passing to the cells of the posterior pole as to be finally visible only as a minute refringent reddish globule pushing out the protoplasm of the cell slightly in the same way as the larger anterior "eye-spots" push out the superficial plasma of the cells of the anterior pole.

It is therefore plain that if these organs are visual or sensitive to light or any other natural agent, they are best developed in just the position in which they are of the most service to the organism, viz., at its anterior pole. These facts raise the query whether Ehrenberg was not after all justified in regarding the reddish spot in each cell of the colony as *eyes.* While these eyes are obvious to any observer it is remarkable that no one has hitherto called attention to their very unequal development at

the anterior and posterior poles of Volvox. It is equally remarkable that none of the extant figures of Volvox correctly represent the definite relation of position of the "eye-spots" to the axis of rotation of the whole cænobium or colony and the flagella of the cells.

The facts which are here noted in regard to Volvox serve rather to strengthen the claims of zoologists to this singular organism, which is actually found to combine features of the vegetable and animal world in its physiological activities. While its respiration, chlorophyl, and modes of reproduction seem to affiliate it with the plant kingdom, the obvious differentiation of a system of anterior organs, which refuse any other identification than that of sensiferous structures give it claims upon the animal kingdom. If we look upon Volvox as a form which has permanently not passed beyond the ideal blastula stage and which lies near the point of divergence of Metaphyta from the Metazoa we shall probably assign it to nearly its true position. It has many interesting features, one of which is its blastula-like form; its cells embedded in cellulose and united by protoplasmic bonds into a sort of syncytium; its differentiation of a directive anterior empty pole apparently provided with a more specialized sensory apparatus, as pointed out above, and of a posterior reproductive pole or hemisphere, in the cells of which the supposed sensory apparatus is so reduced in importance as to have been nearly suppressed. Carrying our reflections farther, we may be permitted to suppose that conditions of organization may and do exist, as evidenced in Volvox as here described, in which structures and functions may be manifested, which we must regard as sensiferous, yet in so low and generalized a form in a blastula-like type, that we find the organs developed in every cell, the only evidence of differentiation or specialization obtainable being that which occurs at that pole of the blastula which is habitually brought into the most important or dangerous relation to the environment. The end result being that a type comparable to the hollow blastula has the sensiferous apparatuses of the cells at its constant anterior pole better developed than in

those around its equator and still better than in those at its constant posterior pole. The diffusion or extension of the primordial visual apparatus of the protozoan grade such as is seen in Euglena, is a result merely, in Volvox, of the permanent attainment of the colonial grade of development which has ended in a sort of blastula-like form, each cell of which is provided with a sense organ. In other words we have in Volvox a blastula-like type with a sensory apparatus apparently developed at its anterior pole, while at its posterior pole this sensory apparatus is so little developed as to be nearly absent, possibly owing to disuse. The degree of development of this supposed sensiferous apparatus at opposite poles in Volvox stands in an obvious relation to the respective importance of such a contrivance at those poles in relation to the welfare of the organism. It is probable that, if what I have here described is really a visual or other sensory apparatus, it is the most primitive and unspecialized compound sensiferous organ yet detected in the living world. At any rate it is probably to be regarded as a compound organ in the same sense that the retina and ommatidia of other and higher forms are to be regarded as compound organs in that they are cellular aggregates. The further study of these remarkable structures and relations in Volvox is desirable, and as the organism is accessible to many students it is to be hoped that such study may not be long delayed, and that not only a more careful study of the minute structure of the "eye-spots" may be carried out, but also that figures will be produced which will give adequate prominence to the most important of the facts which I have here attempted to put upon record.

THE DEVELOPMENT OF THE THEORIES OF CRYSTAL STRUCTURE.[1]

IN 1822, the Abbé Haüy[2] declared that since all crystals of the same substance, whatever their external form, may be

[1] Abstracted by. W. S. Bayley from an article by H. A. Miers in *Nature* of January 17, 1889.

[2] "Traité de Cristallographie." (Paris, 1822.)

reduced by cleavage to the same solid figure, this cleavage solid has the form of the ultimate particles into which any crystal may, in imagination, be separated by repeated subdivision, and that this is, therefore, the form of the structural unit, although not necessarily that of the chemical molecule. Hence a crystal is to be regarded as constructed of polyhedral particles, having the form of the cleavage fragment, placed beside one another in parallel positions. A crystal of salt, for example, which naturally cleaves parallel to the faces of the cube, is constructed of cubic particles.

Upon the relative dimensions of the structural unit depends the form assumed by the crystals of a given substance.

This theory not only accounts for the existence of cleavage, but further defines the faces which may occur upon crystals of a substance having a given cleavage figure; for, if once it is assumed that a crystal-face is formed by a series of the particles whose centres lie in a plane, it follows that all such planes obey the well-known law which governs the relative positions of crystal-faces.

A natural advance was made from the theory of Haüy, without detracting from its generality, by supposing each polyhedral particle in Haüy's system to be condensed into a point at its centre of mass, so that the positions of the molecules, and therefore of the crystalline planes, remain the same as before; but the space occupied by a crystal is now filled, not by a continuous structure resembling brickwork, but by a system of separate points.

In such a system of points, if the straight line joining any pair be produced indefinately in both directions, it will carry particles of the system at equal intervals along its entire length; in other words, all the structural molecules of a crystal must lie at equal distances from each other along straight lines. The interval between particles along one straight line will, in general, be different from those along another, but the molecular intervals along parallel straight lines will always be the same.

Bravais,[1] following in the steps of Delafosse and Franken-

[1] "Etudes cristallographiques." (Paris, 1866.)

Fig. 12.

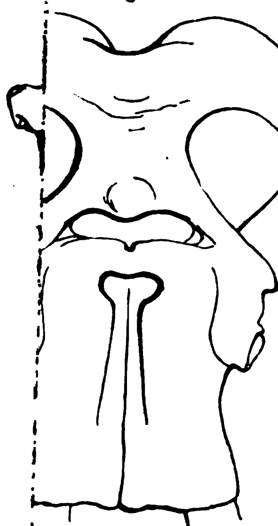


Fig. 12a.

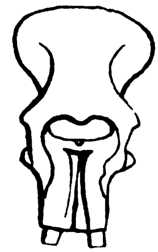


Fig. 13.

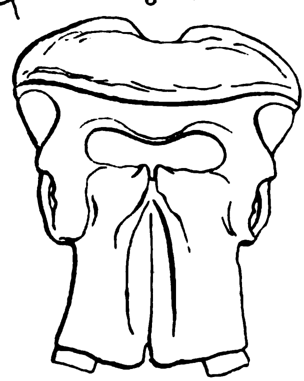
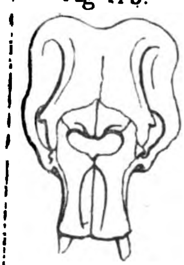


Fig 14b.



14 a.

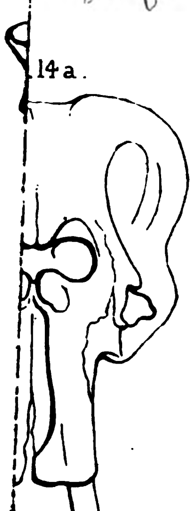
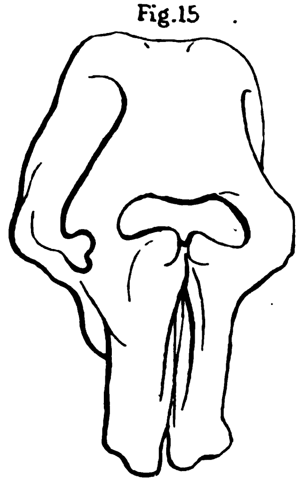


Fig. 15.



heim, investigated the possible ways in which a system of points may be arranged in space so as to lie at equal distances along straight lines—in other words, so as to constitute what may be called a ***solid network*** (*assemblage*, *Raumgitter*).

The geometrical nature of a network may be best realized as follows: Take any pair (O C_1) of points in space, draw a straight line through them, and place points at equal distances along its entire length (C_2, C_3, . . .); such a line may be called a ***thread*** of points (***rangée***). Parallel to this line, and at any distance from it, place a second thread of points (A_1 a_1), identical with the first in all respects; in the plane containing these two threads place a series of similar equidistant parallel threads (A_2 a_2, &c.) in such positions that the points in successive threads lie at equal intervals upon straight lines whose direction (O A_1) is determined by the points upon the first two threads. Such a system of points lying in one plane may be called a ***web*** (***réseau***). Now, parallel to this plane, and at any distance from it, place a second web (B_1 b_1), identical with the first. Finally, parallel with these, place a series of similar equidistant webs in such positions that the points in successive planes lie at equal intervals upon straight lines whose direction (O B_1) is determined by the points in the first two webs.

In this way a ***network*** of points is constructed, in which the line joining any two points is a ***thread***, and the plane through any three points is a ***web***.

The space inclosed by six adjacent planes of the system, having no other points of the network between them is a parallelopiped (O A_1 B_1 C_1), from which the whole system may be constructed by repetition, and which may be taken to represent the structural element (***molécule soustractive***) of Haüy.

The complete investigation of all possible solid networks led Bravais to the conclusion that these, if classified by the character of their symmetry, fall into groups, which correspond exactly to the systems into which crystals are grouped in accordance with their symmetry.

It follows that two (not, however, independent) features of crystals are fully accounted for by a parallelopipedal arrange-

ment of points in space—namely, the symmetry of the crystallographic systems and the law which governs the inclinations of the faces (law of rational indices).

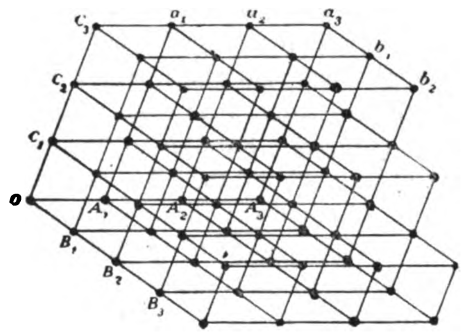


Fig 1

There are, however, subdivisions of the various systems consisting of the merohedral or partially symmetrical crystals belonging to them, which are not explained by the geometry of a network; these consequently were referred by Bravais, not merely to the arrangement of the molecules in space, but also to the internal symmetry of the molecule itself.

Hence the theory of Bravais, while able to a certain extent to explain the form of crystals, requires an auxiliary hypothesis if it is to explain those modifications which are partially symmetrical or merohedral.

Sohncke,[1] treating the problem in a different manner, and reasoning from the fact that the properties of a crystal are the same at any one point within its mass as at any other, but different along different directions, inquired in how many ways a system of points may be arranged in space so that the configuration of the system round any one point is precisely similar to that round any other. Such a configuration may be called a *Sohncke system* of points in space (*regelmässiges Punktsystem*).

From his analysis of this problem, it appears that there are

[1] "Entwickelung einer Theorie der Krystallstruktur." (Leipzig, 1879).

sixty-five possible Sohncke systems of points, and that these may be grouped according to their symmetry into six classes, corresponding to the six crystallographic systems; and further that there are within each class minor subdivisions, characterized by a partial symmetry corresponding to the hemihedral and tetartohedral forms of crystallographers.

The theory of Sohncke contains within itself the essential features of a Bravais network of structural molecules, and also the auxiliary hypothesis regarding the arrangement of parts within the molecules which is required to account for merohedrism. On close examination the arrangement of Sohncke proves to be a simple extension of that of Bravais.

Each of Sohncke's arrangements may be regarded as derived from one of the parallelopipedal networks of Bravais if for every point of the latter be substituted a group of symmetrically arranged satellites. It is not necessary that any particle in a group of these satellites should actually coincide with the point of the Bravais network from which the group is derived; and the points of the Sohncke system do not themselves form a network; it is only when all the points in each group of satellites are condensed into one centre that a Sohncke system coincides with a Bravais network.

To any particle of one of the satellite groups corresponds in every other group a particle similarly situated with regard to the point from which the group has been derived. Every such point may be said to be homologous with the first.

Each complete set of homologous points is itself a Bravais network in space, and consequently a Sohncke system may be regarded as a certain number of congruent networks interpenetrating one another: the number of such networks, in general, being equal to the number of points which constitute each group of satellites.

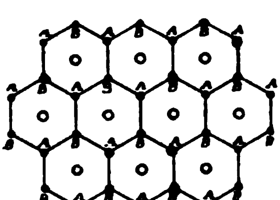


Fig 2

The relation of a Sohncke system to the network from which it is derived may be illustrated by a bees'-cell distribution of points in one

plane, *i. e.*, by points which occupy the angles of a series of regular hexagons. Thus, in the adjoining figure the dots form a Sohncke system in one plane, since the configuration of the system round any one point is similar to that round any other; but they do not form a Bravais web, since the points do not lie at equal distances along straight lines.

If, however, points, represented in the figure by the circles O, be placed at the centres of the hexagons, they will by themselves constitute a web, and the hexagonal system may be derived from this web by replacing each of its points by a group of two satellites, A and B. Or, from the second point of view, the arrangement may be regarded as a triangular web, containing the points A, completely interpenetrated by a similar web, containing the points B.

It is a remarkable feature of the Sohncke systems that some among them are characterized by a spiral disposition of the particles along the threads of a right- or left-handed screw: now this spiral character, which does not belong to any of the Bravais networks, supplies a geometrical basis for the right- or left-handed nature of some merohedral crystals which possess the property of right- or left-handed rotary polarization.

The theory of Sohncke, as sketched above, appeared to be expressed in the most general form possible, and to include all conceivable varieties of crystalline symmetry.

It has, however, recently been pointed out by Wulff[1] that the partial symmetry of certain crystals belonging to the rhombohedral system—that, namely, of the minerals phenacite and dioptase—is not represented among the sixty-five arrangements of Sohncke.

Other systems of points in space have also been studied by Haag[2] and Wulff, which do not exactly possess the properties of a Sohncke system, and yet might reasonably be adopted as the basis of crystalline structure, since they lead to known crystalline forms.[3] These, however, and all other systems of

[1] *Zeitschr. f. Kryst.* xiii. (1887) p. 503.
[2] "Die regulären Krystallkörper." (Rottweil, 1887.)
[3] Cf. W. Barlow, *Nature*, xxix. (1884) pp. 186, 205.

points which have been proposed to account for the geometrical and physical properties of crystals, may be included in the theory of Sohncke after this has received the simple extension which is now added by its author.

In Bravais's network all the particles or structural elements were supposed to be identical, and in Sohncke's theory also there is nothing in their geometrical character to distinguish one particle from another.

In Fig. 2, the hexagonal series of dots may, as was said above, be regarded as composed of a pair of triangular webs, A and B; now these, although identical in other respects, are not parallel, for the distribution of the system round any point of A is not the same as that round any point of B until it has been rotated through an angle of 60°.

It is possible, however, to conceive similar interpenetrating networks which differ not only in their orientation but even in the character of their particles. The centre of each hexagon, for example, may be occupied by a particle of different nature from A and B to form a new web, O. The three webs are precisely similar in one respect, since their meshes are equal equilateral triangles; moreover, if the *position* of the points alone be taken into account, the whole system would form a Bravais web, *i. e.*, if the particles of O were identical with those of A and B. If, however, as is here supposed, the set O consists of particles different in character from A and B, the distribution round any point of O is totally distinct from that round any point of A or B. The points O are geometrically different from the points A B. The web A is interchangeable with B, but O is interchangeable with neither The interpenetrating networks are no longer to be regarded as consisting necessarily of identical particles, if an explanation is to be given of all the geometrical forms existing in nature.

The above figure represents a Sohncke system, A B, of particles of one sort interpenetrated by a Bravais web, O, of another sort; but there is no reason why two or more different Sohncke systems, no one of which is identical with a Bravais network, may not interpenetrate to form a crystal structure.

In its most general form, then, the theory may now be expressed—

A crystal consists of a finite number of interpenetrating Sohncke systems which are derived from the same Bravais network. The constituent Sohncke systems are in general not interchangeable, and the structural elements of one are not necessarily the same as those of another.

Or, since each Sohncke system consists itself of a set of interpenetrating networks, the theory may be thus expressed—

A crystal consists of a finite number of parallel interpenetrating congruent networks: the particles of any one network are parallel and interchangeable; these networks group themselves into a number of Sohncke systems in each of which the particles are interchangeable but not necessarily parallel.

The number of kinds of particles which constitute the crystal may therefore be equal to the number of Sohncke systems involved in its construction.

The structural units are no longer, as they were in the theory of Bravais, necessarily identical, but may represent atomatic groups of different nature.

The system in Fig. 2 consists of two sets of particles, A B and O; and, if a large enough number of these be taken, any portion of the system (*i. e.* any crystal constructed in this manner) consists of the particles united in the proportion of two of the first group to one of the second. Such an arrangement, then, may represent the structure of a compound, $O A_2$.

"When, for example, a salt in crystallizing takes up so-called water of crystallization which is only retained so long as the crystalline state endures, the chemical molecule salt + water cannot be said to exist except in the imagination, for the presence of such a molecule cannot be proved. To obtain an easily intelligible example, without, however, pronouncing any opinion as to whether it may be realized, imagine the centred hexagons in the figure to be constructed in such a way that each corner consists of the triple molecule $3\ H_2O$, and each centre consists of the molecule R. The chemical formula would then be $R + 6H_2O$, and yet a molecule of this constitution

would not really exist; on the contrary, the structural elements in the crystallized salt would be of two sorts—namely, R and $3H_2O$."[1]

Hence it is geometrically possible that the structural elements of a crystal may be different atomic groups which are held in a position of stable equilibrium by virtue of being interpenetrating networks.

A GENERAL PRELIMINARY DESCRIPTION OF THE DEVONIAN ROCKS OF IOWA; WHICH CONSTITUTE A TYPICAL SECTION OF THE DEVONIAN FORMATION OF THE INTERIOR CONTINENTAL AREA OF NORTH AMERICA.

BY CLEMENT L. WEBSTER.

The area of the Devonian rocks in North America presents at least four distinct types of stratigraphy in their sections, in different parts of the continent.

The four types blend, more or less, at their borders, but in their central area are quite distinct.

The four areas may be called,—

(1) "*The Eastern Border Area,*" including the outcrops of Gaspé, New Brunswick, Maine, and other places in Northern New England.

(2) "*The Eastern Continental Area,*" including the New York and Appalachian tracts as far South as West Virginia, and extending Northwestward into Canada West and Michigan.

(3) "*The Interior Continental Area,*" typically seen in Iowa, and extending into Missouri, Illinois, Indiana, and probably Northward toward the valley of the Mackenzie River, and—

(4) "*The Western Continental Area,*" best known through Hague and Walcott's studies of the Eureka, Nevada, sections.[2]

Each of these four types presents sections of the Devonian, which

1 Sohncke, *Zeitsch. f. Kryst.* xiv. p. 443.

2 This classification of (in part) Professor H. S. Williams (American Geologist, Special Number, October, 1888, p. 228) we here adopt, provisionally.

in most of the details of stratigraphical, lithological and palaeontological composition, differs greatly from the others; although all at the same time, by various links of evidence, demonstrate that they represent the same geological age, and usually show, more or less distinctly, a similar order of sequence.

In this report it is our aim to deal, more particularly, with the typical section (Iowa) of the Interior Continental Area.

The area of surface occupied by the rocks of Devonian age in Iowa comprises a wide strip of country, the general trend of which is Northwestward and Southeastward.

It is about two hundred miles in length and fifty miles in width; the general details of its outlines may be seen upon the geological map of the State; which, however, demands some important modifications.

The rocks of this age, in Iowa, have been referred by geologists to different epochs; for instance, the shales and sandstone, which occupy the upper portion of the Devonian stratum near the mouth of Pine Creek, and at other points on the Mississippi, to the Chemung group; and the limestone and shales, occupying a "lower"? horizon, at Davenport, Iowa City, Independence, &c., and the shales at Rockford and Hackberry, to the Hamilton Group (Hall's Geology of Iowa, VOL. I. PART 1 and 2, 1850).

The rocks also at Cedar Falls, have been referred by Professor A. H. Worthen, to the Chemung group (*Loc. cit.*)

Some years later, in 1873, a reëxamination of some of the rocks of this age was made by Hall and Whitfield, and the limestone at Waterloo, and the shales at Rockford, were declared to be the equivalents of the New York Corniferous and Chemung Groups, respectively (23d Report on State Cabinet of New York, pp.,223-226) Again, Prof. H. S. Williams, in 1883 (American Journal of Science, February, 1883), referred the shales at the top of the Devonian, at Rockford and Hackberry, to the base of the Chemung of the New York Geologists, and, more recently, to the upper part of the Hamilton of the New York Section (American Geologist, Special Number, 1888, pp, 240, 242, &c.).

On the other hand, Dr. C. A. White (Geology of Iowa, 1870, VOL. I., p. 178) is of opinion that *all* the Devonian strata of Iowa, belong to a single epoch, the Hamilton.

By various other writers, the rocks of this age have been referred to each of the several divisions of the New York section.

The thickness of the Devonian rocks of Iowa, have been variously estimated by different writers on the subject, at from 150 feet to 200 feet.[1] This formation is quite conformable both with the Niagara rocks below, and the Carboniferous rocks above, throughout nearly, or quite their entire extent in the State. These rocks, as they occur in this State, are separable into *three* general, more or less well marked lithological and palaeontological divisions, and whose order of sequence can be made out.

The lowest division of this section, which, in its general lithological character, as observed in its Eastern extension at different points along the Mississippi, at, and adjacent to Davenport, is a rather hard, gray, brown, and buff limestone; at times somewhat arenaceous and argillaceous, with slight intercalated beds of shale, and gray and brown brecciated limestone, sometimes attaining a thickness of eight feet. A portion at least, of the rocks of this division, are here separated from the underlying Niagara limestone by a fault, the space being filled by coal measure deposits.[2]

This formation carries, at different horizons, a rich and varied fauna; while at other horizons, the strata are devoid of organic remains.

These rocks contain a fauna which represents both the Corniferous, Hamilton, and Chemung faunas, as well as a few forms characteristic of the Trenton and Niagara rocks below. Of the very large numbers of species of fossils (more than two hundred) collected from these rocks, over three-fourths are found to be characteristic of the Corniferous epoch. Of those forms representing the fauna of other epochs, their ratio of occurrence is, as in the following order: Hamilton, Niagara, Chemung and Trenton.

Or in other words, the larger number are peculiar to the Hamilton group, the second largest number are peculiar to the Niagara group, the third Chemung, and the fourth Trenton.

The following enumeration is that of some of the species characteristic of this division:

Arcophyllum oneidense	Cladopora fisheri
Callonema bellatulum	Cystiphyllum impositum
Callonema lateradum	Cystiphyllum vadum

[1] Hall's Geology of Iowa, Vol. I., Part I, 1858; C. A. White, Geology of Iowa, 1870; J. D. Dana, Manual of Geology, p 267; H. S. Williams, American Geologist, Special Number, October, 1888, p 233.

[2] A. S. Tiffany, Geology of Scott County, Iowa, and Rock Island County, Illinois, &c., p. 13.

Diphyphyllum simcoense
Orhoceras faculum
Strophodonta nacrea
Syringopora perelegans
Syringostroma densum
Zaphrentis nitida
Acrophyllum oneidaense
Alveolites subramosus
Atrypa hystrix
Aulacophyllum convergens
Aulacophyllum princeps
Blothrophyllum promissum
Centronella hecate
Chonophyllum vandum
Cladopora pinguis
Cladopora robusta
Clisiophyllum ohioense
Callonema imitator
Cyathophyllum clintonensis
Cyathophyllum cornicula
Cyathophyllum impositum
Cystiphyllum ohioense
Favosites canadensis
Favosites limitaris
Orthis iowensis
Platyceras carinatum
Pleurotomaria hebe
Phillipsastrea gigas
Spirifera fimbriata
Spirifera gregaria
Spirifera varicosa
Strophodonta hemispherica
Terebratula elia
Zaphrentis compressa
Zaphrentis exigua
Zaphrentis prolifica
Zaphrentis wortheni[1]
Leperdita cayuga
Productella subaculeata
Syringopora nobilis
Syringostroma columnare
Zaphrentis exigua
Zaphrentis subconstricta
Alveolites squamosus
Atrypa aspera
Atrypa reticularis
Aulacoplylum reflexum
Bellerophon pelops
Centronella glansfagea
Chonetes lineata
Cladopora labiosa
Cladopora pulchra
Clisiophyllum convergens
Crania bordeni
Cyathophyllum arctifossum
Cyathophyllum coalitum
Cyathophyllum conigerum
Cyathophyllum houghtonii
Cyathophyllum davidsonii
Favosites basalticus
Favosites emmonsii
Naticopsis humilis
Paracyclas lirata
Pleurotomaria aplata
Pleurotomaria rotalia
Proetus canaliculatus
Spirifera mucronata
Spirifera euruteines
Strophodonta concava
Strophodonta patersonii
Zaphrentis cruciforme
Zaphrentis conigera
Zaphrentis gigantea
Zaphrentis ungula

[1] For a portion of this list of species we are indebted to Mr. A. S. Tiffany, of Davenport, Iowa.

No well-marked lithological or biological sub-division of these rocks has been observed.[1]

In the eastern extension of the Corniferous rocks, in Iowa, they are seen to be succeeded upward by gray, brown and buff, calcareous and argillaceous shales, limestone, and coarse and fine-grained sandstones of the Hamilton group.

While at some localities the two divisions are sharply defined, both lithologically and biologically, still at other points these characters of the two formations so gradually blend as to make it a matter of great difficulty, if not an impossibility, to designate just where the line of separation between the two groups should be drawn.

As might be naturally expected, throughout the area occupied by these divisions, the mingling of their faunas is much more strongly marked at their junction with each other.

In their interior area, the line of division between the two groups is nowhere distinctly shown, either by lithological or biological evidence. According to the record of the boring of the artesian well at Davenport, kindly furnished me by Mr. A. S. Tiffany, and which may be considered as approximate, the thickness of the Corniferous rocks, in that vicinity, is shown to be one hundred and eighty feet.

At one locality, Independence, the Corniferous limestones are succeeded upward by a blue shale, which here forms the base of the Hamilton, and which, from its order of sequence, we would consider to be the equivalent of the "Marcellus Shales" of eastern sections, although differing in some respects, in its lithological and biological characters, from them.

The beds of this serial are somewhat variable, lithologically, consisting of thin bands of concretionary limestone, and dark blue, argillaceous, fine-grained shales, which are highly charged with bituminous matter, and interlaminated by seams of coal, from one-eighth to one-fourth of an inch in thickness. This shale weathers, on exposure, to a light blue clay, and contains an abundance of fossil shells, a few species of corals and cerinoid remains; while some of the beds hold numerous remains of land plants (*Lepidodendron* and *Sigillaria*).

[1] This Division has been referred, by Rev. Dr. Barris, to the Upper Helderberg, and its thickness estimated at nearly one hundred feet, ("Local Geology of Davenport and Vicinity.") Proceedings of Davenport Academy of Science, Vol. II, 1880. This formation has also been referred to the Corniferous, by Mr. A. S Tiffany, (Geology of Scott County, Iowa, and Rock Island County, Illinois, etc., 1885.)

This division represents an old shore deposit, and carries, in its fauna and flora, evidence both of its terrestial and marine origin; and marks, as well, the dawn and culmination of terrestial vegetation of the old Devonian time, in Iowa.

The thickness of this division is probably thirty feet or more, although only about twenty-five feet have actually been observed.

These shales, which represent only a *local* sub-division of the Hamilton, were first recognized by Mr. D. S. Deering, of Independence; and subsequently described by Prof. S. Calvin, as "Some Dark Shales Below the Devonian Limestone at Independence, Iowa" (Bulletin of U. S. Geological Survey, Vol. IV., No. 3, 1878.)

In this publication, the statement was made (p. 726) "That the shale in question is not a mere local deposit, but is distributed all along the outcrop of the Devonian Rocks of Iowa."

An extended study of all the Devonian rocks of this State, and the record of numerous borings along its Eastern outcrop, and at other points, has failed to adduce any evidence of the existence of this formation at other localities.

One of the highest members of the Hamilton, in its Eastern extension, is a soft, friable, brownish-yellow sandstone, which is well shown as it out-crops on Pine Creek, some distance above "Pine Creek Mill." This stratum of sandstone here forms a bold escarpment or cliff, about forty feet in height, is obliquely and discordantly stratified throughout, dips rapidly in a southerly direction, and is, so far as observed, devoid of fossils.

At Independence, the blue shales (equal Marcellus Shales) are succeeded upward by heavy bedded, sometimes indistinctly stratified dove-colored and buff limestone, and intrusive beds of shale, with a thickness of twenty-one feet. The lower portion of the limestone here is indistinctly stratified, but is often crossed diagonally and irregularly by seams which cause it to split into uneven slabs and fragments.

As we recede to the West and Northwest from the attenuated Eastern outcrop of the Hamilton, the rocks overlying the blue shales are seen to rapidly increase in thickness, until, on the Wapsipinecan River, only one and one-half miles from the exposure of blue shales they are seen to attain an estimated thickness of sixty-five feet; while on the same stream at Littleton, ten miles to the Northwest, the same rocks are observed to attain a slightly greater thickness.

The following is a partial list of the species occurring at this horizon :

The rocks of the lower portion of the Hamilton are generally heavier bedded, more compact, and uniform in texture, and usually a more pure limestone than those of the upper portion The prevailing color of the strata of this horizon, is blue, and bluish-gray.

In the northern portion of Johnson County, (for instance, at the "State Quarry," Robert's Ferry, Solon, etc.,) occurs a bed of peculiar grayish-white limestone, nothing like it being known to exist in other portions of the State.

This bed has a thickness of from six inches to six feet, or more, is very crystalline throughout, and is made up, to a considerable extent, of broken shells of different species of Brachiopoda, some of which are not known to occur elsewhere in Iowa.

For convenience in subsequent allusion, this bed is here designated the *Shell Bed.*

Underlying this shell bed is a stratum of very hard, fine-grained, blue brecciated limestone.

This limestone is observed at various localities in this portion of the State, and is known to extend as far North as Raymond Station, in Black Hawk County.

The upper portion of this division is made up, for the most part, of thin bedded magnesian and common limestone, and soft, impure, calcareous, argillaceous and silicious, shales and sandstones, of a prevailing grayish-buff color.

In the Eastern portion of Floyd County, some beds of shale, occupying a considerable area, are extensively sun-cracked ; this indicating an elevation of the sea-bottom here, and the exposing of it for some time to etheral conditions and the burning rays of the sun.

The extreme upper portion of this division is almost everywhere, a hard, fine-grained, and brittle, grayish or dove-colored limestone, and singularly devoid of organic remains.

Immediately succeeding the limestone, in portions of Floyd, Cerro Gordo and Worth Counties, and constituting the highest member of the Hamilton group in the State, is a stratum of stiff blue clay, varying from twenty to twenty-five feet in thickness.

This formation, which is entirely devoid of organic remains, may be best seen as it outcrops on Lime Creek and Willow Creek, in Floyd and Cerro Gordo Counties, particularly at Rockford, Hack-

berry, and a locality three miles west from Mason City, on Willow Creek.

This serial, judging from its lithological character and order of sequence, appears to be the equivalent of the "*Genesee Shales*" of the New York section, and to which division we would here refer it.

As we have before intimated, the base of the Hamilton, represented by the blue Shales at Independence, carries a rich Fauna, and evidence, also, of the former existence of a rich, and perhaps varied, flora, which was restricted to this zone.

Of the fossil species occurring in this serial, the following may be enumerated:

Strophodonta arcuata	Strophodonta variabilis
Strophodonta calvini	Strophodonta canace
Strophodonta reversa	Orthis infera
Atrypa reticularis	Atrypa hystrix
Spirifera subumbonata	Rhynchonella ambigua
Gypidula munda	Productus dissimilis
	Lepidodendron and Sigillaria

Also several other undetermined species of Brachiopoda, and corals, and one or two species of crinoids.

Of the above list of species, only two, *Atrypa reticularis*, and *A. hystrix*, are known to occur in the Corniferous limestones below, while only three or four forms are at present known to extend upward into the middle Hamilton, (the shales, limestone, etc., lying above the blue shale and below the blue clay).

The two species *Atrypa reticularis* and *A. hystrix*, as they occur in the overlying rocks, assume a form so altered as to be as readily distinguished as if they were distinct species. The number of blue shale species which occur in the shales at Rockford, is greater than those of all the other divisions combined. A peculiar feature of this blue Shale Fauna, is the depauperation of most of its species.

As to the flora of this division, it is, as we have before stated, indigenous to it; none of the other serials containing any evidence of the former existence of either terrestial or marine plant life.

The rocks of the middle Hamilton carry a rich and varied fauna, more particularly in its lower and central portions.

Athyris vittata
Atrypa hystrix
Aulopora serpens
Aviculopecten pecteniformis
Calceocrinus clarus
Cladopora lichenoides
Cladopora fisherii
Platyceras rectum
Platyceras auriculatum
Crania bordeni
Cryptonella planirostra
Cyathophyllum davidsonii
Cystiphyllum americanum
Phacops bufo
Discina media
Stromatopora alternata
Gomphoceras lunatum
Megistocrinus latus
Meristella haskensii
Monticulipora monticula
Orthis iowensis
Orthis livia
Paracyclas ohioensis
Pentamerella dubia
Favosites hamiltonensis
Platyceras ammon
Platyceras argo
Platyceras bucculentum
Platyceras cymbium
Spirifera aspera
Spirifera ziczac
Spirifera raricosta
Spirifera subvaricosa
Spirifera subattenuata
Spirifera fimbriata
Spirifera mucronata (*rare*)
Spirifera formosa
Streptorhynchus chemungensis
Strophodonta demissa
Zaphrentis exigua

Atrypa reticularis
Aulopora conferta
Aviculopecten parilis
Chonetes pusilla
Chonophyllum ponderosum
Cladopora romerii
Platyceras symmetricum
Platyceras cymbium
Platyceras bucculentum
Crania hamiltonensis
Cryptonella rectirostra
Cyathophyllum scyphus
Heliophyllum halli
Discina doria
Discina seneca
Stromatopora incrustans
Leiorhynchus alta
Megistocrinus farnsworthi
Meristella meta
Euomphalus cyclostomus
Orthis vanuxemi
Paracyclas lirata
Pentamerus comis
Philipsastrea gigas
Favosites niaulus
Platyceras tetis
Platyceras conicum
Platyceras carinatum
Platyceras erectum
Spirifera raricosta
Spirifera tullia
Spirifera varicosa
Spirifera subumbonata
Spirifera pinnata
Spirifera parryana
Spirifera mannii
Spirifera euruteines
Terebratula romingeri
Stromatopora incrustans

In places these rocks contain a rich fish fauna, as well as numerous new and described species of shells, corals, etc., which are not at present known to occur in the rocks of any other area.

The mingling of the lower and upper (Chemung) Devonian faunas is here greater than in any of the other divisions of the rocks of this age in the State.

The grouping of Fossils of the middle Hamilton, differs considerably at different localities; although not to such an extent as has been heretofore generally supposed. The lithological character of the beds of the middle Hamilton, are usually very variable, so variable, indeed, as to make it a matter of great difficulty, and often an impossibility, to trace any particular bed for any considerable distance by this character.

Some portions of the strata of this horizon, as at Charles City and Independence, are traversed by more or less regular wave-like undulations.

The thickness of the Corniferous and Hamilton rocks vary somewhat in different portions of their area.

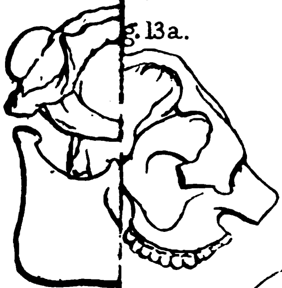
According to the record of the boring of the artesian well at Cedar Rapids,[1] the thickness of the Corniferous and Hamilton strata is, at that place, shown to be 380 feet.

Adding to this thirty feet, for the blue shales at Independence, and fifty feet (estimated thickness) for the Hamilton rocks (including the blue clay at Rockford etc.) lying above the highest beds of the Cedar Rapids section, we have an aggregate thickness, of the rocks of the Corniferous and Hamilton groups in Iowa, of 430 feet.

Succeeding the Hamilton, in the northwest portion of its area, is the highest division of the rocks of this age in the State.

This serial, which is plainly a sequent of the Hamilton, is known to attain a thickness of forty-five feet, and is made up, for the greater part, of a yellowish brown argillaceous, and sometimes slightly arenaceous, shaley limestone, which weathers to a stiff yellow, sometimes light buff, clay; and in places contains considerable numbers of ferruginous concretions. These shales are sharply defined, both serially, lithologically, and palaeontologically, and are a vast repository of beautifully preserved fossil remains; a large majority of which are peculiar to them.

[1] We are under obligations to C. J. Fox, Esq., superintendent of the Cedar Rapids Water Co., for a record of this boring, together with samples of the rocks (2225 feet) passed through.



g. 13 a.

Fig. 14.

Fig

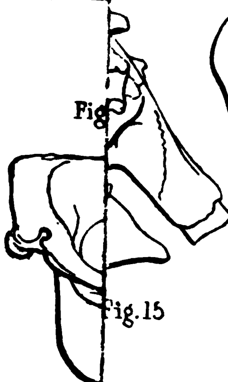


Fig. 17.

Fig. 15

Fig. 7.

g 17a

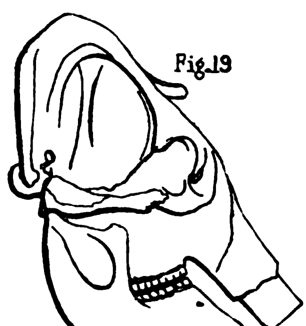


Fig. 19

Fig.

b.

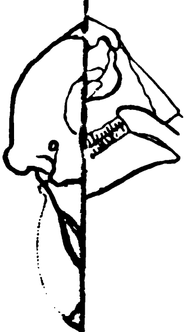


Fig. 11.

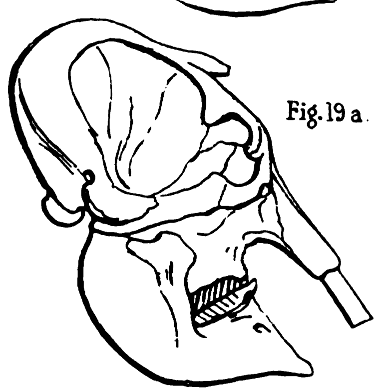


Fig. 19 a.

This formation carries *two* faunas; one at the base, and another occupying the remainder of the division.

The fauna at the base is represented by considerable numbers of very minute, and finely preserved Brachiopoda, Gastropoda, Crustaceans, Foraminifers and Corals, a large number of which are as yet undescribed.

Not more than one or two of the forms, occurring at the base of the shales, are known to occur outside this formation.

Of the described species of this fauna, the following may be enumerated.

Athyris minutissima. C. L. Webster.
Platystoma mirum. Webster.
" pervetum. Webster.
Naticopsis rarus. Webster.
Turbo strigillata. Webster.
" incerta. Webster.
Holopea tenuicarinata. Webster.
Cyclonema brevilineatum. Webster.
" subcrenulatum. Webster.

For a more detailed description of this fauna etc., reference may be made to a paper on "Description of New Species of Fossils From the Rockford Shales of Iowa," which appeared in the November number of this Journal for 1888.

Of some of the described species which constitute the fauna of the higher horizon, and which are mostly typical of it, the following may be given.

Rhynchonella subacuminata. Webster
Paracyclas sabini. White.
" validalinea. Webster.
Atrypa reticularis.
" hystrix.
" " *var* planosulcata. Webster.
" " *var* elongata. Webster.
Spirifera whitneyi
" hungerfordii.
" strigosus. Meek, (*S. orestes*, H. and W).
" substrigosus. Webster.
" norwoodii. Meek, (*S. cyrtinaeformis*, H. and W).
" fimbriata.
" macbridei.

Smithia fohnanni.
" multiradiata.
Stromatopora incrustans.
" expansa.
" solidula.
Caunopora planulata.
Fistulipora occidens.
Alveolites rockfordensis.
Aulopora iowensis.
" saxivadum.
Zaphrentis solida.
Campophyllum nanum.
Chonophyllum ellipticum.
Cystiphyllum mundulum.
Spirorbis arkonensis.
" omphalodes.
Acervularia inequalis.
Callonema lichas.
Stromatopora alternata.
Crania famelica.
Strophodonta arcuata.
" reversa.
" demissa.
" canæ.
" variabilis.
Productus dissimilis.
Streptorhynchus chemungensis..
Orthis iowensis.
Leiorhynchus iris.
Terebratula navicella.
Cryptonella salvini.
Naticopsis giganteum.
Loxonema pexatum.
" crassum. Webster.
" iowense. Webster.
" giganteum. Webster.
Pachyphyllum woodmanii.
" crassicostatum. Webster.
" ordinatum. Webster.
Pachyphyllum crassum. Webster.

Platystoma lineatum.
Ambocoelia umbonata.
Productella truncata.

Aside from the foregoing enumeration, we have in our cabinet, large numbers of undescribed forms. Two-thirds or more, of the species which constitute the fauna of this horizon, are not known, at present, to occur outside of it.

When species, common to the shales, occur in any of the rocks below, and when fossils, peculiar to the lower groups, extend upward into the shales, they usually appear under a form, so altered that specimens from the different formations may be distinguished as readily as if they were distinct species.

About one-third of the species of the upper shale fauna occur in other divisions of the Devonian of this area, as well as most other areas of North America; and very closely allied forms also occur in the European strata of this age (see description and figures of fossils in the geology of Russia and the Ural mountains etc.; also Walcott's Monograph, Palaeontology of the Eureka District, U. S. Geological Survey, 1884, and U. S. Geological Survey of Fortieth Parallel, Vol. IV; as well as a paper by H. S. Williams, "On a remarkable Fauna at the base of the Chemung group of New York," American Journal of Science, February, 1883).

For a more detailed description of this formation, and its faunas, reference may be made to the following preliminary reports, which appear in various numbers of this Journal for 1888. "Notes on the Rockford Shales," and "Description of new species of Fossils from the Rockford Shales of Iowa," also "Contributions to the knowledge of the Genus Pachyphyllum," and "Description of new and imperfectly known species of Brachiopoda from the Devonian rocks of Iowa;" as well as to a paper on "A description of the Rockford Shales of Iowa." which is accompanied by a map of the area occupied by the shales, that appears in Vol. V. of the Proceedings of the Davenport Academy of Science.

From the description of this formation here, and in previous preliminary reports, it will be seen in reality, to constitute a *new and distinct group of strata*, carrying *two* rich and varied faunas; but which has not heretofore been recognized as such, and which is not developed in any other area in North America, or Europe; although *all* contain links of evidence which demonstrate its Devonian age.

For this group of strata, heretofore provisionally designated by us as the "Rockford Shales," we would propose the name *Hackberry Group*, from Hackberry, in Cerro Gordo county, Iowa, where the most extensive and typical exposure of this formation isobserved.

In our forthcoming Monograph on the Devonian formation of Iowa, alluded to in a former paper (" Description of new species of Fossils from the Rockford Shales of Iowa," this Journal for November, 1888) a detailed description of the rocks of its several divisions, together with a list of all the Fossil species known to occur in them, will be given.

CONCLUSIONS.

It is thus shown, 1st, that the type section (Iowa) of the central continental area, differs materially from the type sections of other areas of North America.

2d. That there were nearly or quite as striking alterations of conditions during the successive deposition of strata in Iowa, as are indicated at the east, and that the rocks of this section are separable into well-marked natural divisions and subdivisions, not heretofore generally recognized as such.

3d. That the Devonian rocks of Iowa, instead of attaining a thickness of only one hundred and fifty feet to two hundred feet, as given by previous writers, are now known to attain an aggregate thickness of four hundred and seventy five-feet.

4th. That the Corniferous limestone is developed in Iowa to a thickness varying from one hundred and eighty feet to two hundred feet, and carries a fauna which is, to a great degree, peculiar to this stage.

5th. That the Corniferous limestone is succeeded upward by shales, limestones, clays, and sandstone of the Hamilton group.

6th. That the base of the Hamilton is marked, locally, by a thirty foot stratum of Blue Shales, carrying a peculiar fauna and flora which represents the "*Marcellus Shales*" of eastern areas, but which has not been heretofore so recognized.

7th. That what has been designated, by most writers on the subject, as Corniferous, Hamilton, and Chemung, limestone, sandstone, and Shales, does in reality represent the *Middle* Hamilton.

8th. That the upper portion of the Hamilton, in the northwest portion of its area, is represented by a stratum of blue clay from twenty to twenty-five feet in thickness, which, though devoid of Fossil remains, yet represents, in its order of sequence, the "*Gen-*

esee Shales" of eastern sections; and the present writer is the first to recognize it as such.

9th. That in the Iowa section is represented (so far as is at present known) the extreme western, attenuated, representatives of the eastern "*Marcellus Shales*" and "*Genesee Shales.*"

10th, That the upper Hamilton (blue clay) is succeeded upward by a stratum of Argillaceous Shales, which everywhere occupy the highest position in the Devonian series in the State, and has an observed thickness of forty-five feet; although known to have attained a greater thickness prior to the glacial period, during which time they were more or less extensively eroded.

11th. That these Shales, which have been designated (provisionally) by the writer, in all his preliminary reports, as the "Rockford Shales," constitute, lithologically, stratigraphically, and biologically, a *new* and heretofore unrecognized (as such) group of strata, and which is not developed in any other area in North America, or Europe; although *all* contain links of evidence which demonstrate its Devonian age, and for which the writer has in this report proposed the name *Hackberry Group.*

EDITOR'S TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The Philadelphia Academy of Natural Sciences has recently attacked the problem of original research in a practical manner. For many years the activity of the institution was restricted to the publication of work produced by scientific specialists on material contained in their own collections, and in the museums of other institutions. To this function it subsequently added that of giving instruction to classes in the natural sciences. We have often pointed out that the former line of activity is not enough for an institution which at one time was the only academy of original research in this country; and we have also expressed the opinion that the teaching of the natural sciences to classes of beginners, is not one of its proper uses. We have schools for teaching elsewhere, but

academies of original research are too few for any one of them to be diverted from its proper object.

Recently the management of the Academy has undertaken some explorations in the Bermuda Islands, and the results are coming into print. Large collections of Invertebrata were made, and reports on these by Professor Heilprin are being published in the Proceedings. These embrace much matter of interest, and illustrate what can be done with a moderate outlay in regions not remote. The recent appropriation by the State of Pennsylvania of $50,000 to the institution comes at a favorable period for advancing this excellent work. There are various ways in which this can be done. Our own belief has been and still is, that the best possible use for money at the present time is the endowment of some of the professorships which are as yet unoccupied. The most important agency in original research is men of ability and energy. They can be relied upon to obtain material more cheaply and effectively than persons not familiar with specialties. And these men should be members of the governing body of the Academy, ex-officio.

In case the Academy should adopt such measures the wealthy citizens of Philadelphia cannot better advance the general intelligence as well as the reputation of their community, than by sustaining them by material aid. A new wing should be added to the present building, with improved facilities for work and better light in some of its departments than the present building affords. The new wing should be erected for a smaller sum than the old one cost.

At its April meeting the United States National Academy of Sciences elected officers for six years; elected five new members, and some foreign correspondents; and conferred the Watson and Draper medals. Most of the old officers were reelected, a new Vice-President (Prof. S. P. Langley), and a new member of the council being exceptions. In reelecting the incumbent of the office of President, the Academy made a mistake which it cannot afford. This is to be regretted, as the

Academy is not as well known in the country as it should be, and of course it is important that when and where it is known, nothing should detract from the respect with which its acts should be regarded. No organization allied to the Government can expect to escape the pressure of interests involved, but it is an omen of evil when the interests of persons override the interests of science and of the Academy. The majority of the Academy has not in this instance the excuse of ignorance, and one is lead to fear that not a few of their number deliberately approve of methods that bring science into disrepute, and justify reflections on that country and on that society where they are not only tolerated, but rewarded.

The American Society of Psychical Research has made an appeal for money with which to carry on its work. We hope that this appeal will meet with a prompt and abundant response. The society has done a great deal of excellent work, and the field before it is an immense one. The subject of its researches is of the greatest interest, both scientific and popular, and its importance cannot be overrated. The manner in which its work has been done is worthy of the highest praise, and the country cannot afford to let it languish for want of the necessary assistance. When we consider the comparatively small outlay necessary to the production of its results, we think the endowment of the society one of the most worthy objects that can attract the attention of the liberal.

RECENT LITERATURE.

PLOWRIGHT'S UREDINEÆ AND USTILAGINEÆ.[1]—Students of the fungi may well rejoice that at last we have a book in the English language which discusses with some fulness the structure, biology and classification of the Rusts and Smuts.

[1]*A monograph of the British Uredineæ and Ustilagineæ*, with an account of their Biology including the methods of observing the germination of their spores and of their experimental culture, by Charles B. Plowright, F. L. S., M. R. C. S. [etc.] Illustrated with woodcuts and eight plates. London. Kegan Paul, Trench & Co., 1 Paternoster Square. 1889. 8vo. x., 348 pp.

In this volume, the author, who has long been favorably known as a student of the Rusts more particularly, takes up the various parts of his subject in the following order. viz., Biology of the Uredineæ; Mycelium of the Uredineæ; Spermogonia and the so-called Spermatia; Æcidiospores; Uredospores; Teleutospores; Heterœcism; Mycelium of the Ustilagineæ; Formation of the Teleutospores of the Ustilagineæ; Germination of the Teleutospores of the Ustilagineæ; Infection of the Host-plants by the Ustilagineæ; Spore-Culture; The Artificial Infection of Plants. After this follow the systematic portions including nearly two hundred pages of generic and specific descriptions.

Descriptions, synonymy and references to literature and exsiccati are well worked out. All measurements (which are very generally given) are in micromillimetres. Many biological notes are given after the descriptions, thus adding much to the value of the work.

The genus Uromyces is subdivided as follows into artificial subgenera:

I. Euuromyces:	A.	Auteuuromyces	represented by	11	species.
	B.	Heteruromyces	"	4	"
II. Brachyuromyces,			"	0	"
III. Hemiuromyces,			"	6	"
IV. Uromycopsis,			"	3	"
V. Micruromyces,			"	4	"
VI. Lepturomyces,			"	0	"
Making a total of				28	species.

The genus Puccinia is similarly subdivided:

I. Eupuccinia:	A.	Auteupuccinia	represented by	23	species.
	B.	Heteropuccinia	"	20	"
II. Brachypuccinia,			"	5	"
III. Hemipuccinia,			"	14	"
IV. Pucciniopsis,			"	3	"
V. Micropuccinia,			"	19	"
VI. Leptopuccinia,			"	12	"
Making a total of				96	species

The remaining smaller genera are represented as follows:

Triphragmidium—2 species; Phragmidium—9 species; Xenodochus—2 species; Endophyllum—2 species; Gymnosporangium—4 species; Melampsora—17 species; Coleosporium—4 species; Chrysomyxa—2 species, and Cronartium—1 species. In addition there are descriptions of imperfect forms as follows: Uredo—11; Cæoma—6; Æcidium—21. There are thus descriptions of 167 genuine species, and 38 imperfect forms.

In the Ustilagineæ the genera are represented by species as follows: Ustilago—21; Sphacelotheca—1; Tilletia—3; Urocystis—9; Entyloma—7; Melanotænium—1; Tubercinia—2; Doassansia—2; Thecaphosa—2; Sorosporium—1. The allied and associated species, viz., Graphiola—1; Entorrhiza—1; Tuberculina—1, and Protomyces—5, are added as a supplement, bringing the total of Ustilagineæ up to 57 species. The whole number of descriptions in the book is two hundred and sixty-two.—*Charles E. Bessey.*

RECENT BOOKS AND PAMPHLETS.

Baxter, Sylvester—The Old New World—Salem, 1888. From the Hemingway Archæological Expedition.

Blytt, A.—The Probable Cause of the Displacement of Beach-lines. From the author.

Branner, John C.—The Cretaceous and Tertiary Geology of the Sergipe-Alagôas Basin of Brazil. Transactions of the American Philosophical Society, Vol. xvi, 1889. From the author.

Broom, R.—On a Monstrosity of the Common Earth-worm, *Lumbricus terrestris L.* Transactions Natural History Society, Glasgow. From the author.

Brongniart, Charles—The Fossil Insects of the Primary Group of Rocks. Read before the Manchester Geological Society, Oct. 6, 1885. From the author.

Ellis, Havelock—Women and Marriage, or Evolution in Sex. From the author.

Fewkes, J. W.—On the emission of a colored fluid as a possible means of protection resorted to by Medusæ. Extract Microscopist. From the author.

——— —On the serial relationship of the ambulacral and adambulacral plates in the Star Fishes. Extract Proceedings Boston Society Natural History. From the author.

Hitchcock, C. H.—Recent Progress in Ichnology. Proceedings of Boston Society Natural History, Vol. xxiv. From the author.

Lewis, T. H.—The "Old Fort" Earthworks of Greenup County, Kentucky. Reprint from American Journal of Archæology, Vol. iii, Nos. 3 and 4. From the author.

Lewis, T. H.—Stone Monuments in Southern Dakota. Extract from the American Anthropologist, April, 1889. From the author.

Loomis, Elias—Relation of Rain-areas to Areas of High and Low Pressure. American Journal of Science, Vol. xxxvii, April, 1889. From the author.

McGee, W. J.—Classification of Geographic Forms by Genesis. Reprint from National Geographic Magazine, Vol. i, No. 1. From the author.

Moreno, P. Francisco—Informe preliminar de los Progresos del Museo la Plata, durante el primer semestre de 1888. Presentado al señor Ministro de Obras Publicas de la Provincia de Buenos Aires.

Mourlon, M.—Sur la découvert, a Ixelles (prés-Bruxelles), d'un Ossuaire de Mammifères, antérieur au diluvium. Extrait de Bull. de l'Acad. roy. de Belgique, 3d série, tome xvii, No. 3, pp. 131 and 134, 1889. From the author.

Newton, E. T.—Vertebrata of the Forest-Bed. Extract from Geological Magazine, April, 1889. From the author.

Pelseneer, Paul—Sur la valeur morphologique des bras et la composition du systèms nerveux central des Céphalopodes. Extract Arch. Biol., 1888. From the author.

Penrose, R. A. F.—The nature and origin of deposits of Phosphate of Lime. Bull. U. S. Geological Survey, No. 46. From the author.

Shufeldt, R. W.—Osteology of Circus hudsonius. Extract Journal Comp. Medicine and Surgery, 1889. From the author.

Walcott, C. D.—The Taconic System of Emmons. Extract American Journal Science. From the author.

Welling, James C.—The Law of Malthus. Extract from the American Anthropologist, January, 1888. From the author.

Williston, S. W.—The Sternalis Muscle. Proceedings of the Philadelphia Academy of Natural Sciences. From the author.

Winslow, Arthur—The Construction of Topographic Maps by Reconnoissance Methods. From the author.

Wolterstorff, W.—Die Amphibien Westpreussens. Separat Abdruck aus den Schriften der Naturforschenden Gesellschaft in Dantzig, N. F. vii Bd. 2 Heft. 1889. From the author.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

AFRICA; BORELLI'S TRAVELS IN GALLA-LAND.—Sr. Borelli has surveyed portions of the country to the south of Abyssinia. Mount Harro (3,150 metres) and the Dendigrons of which it forms a part, form the watershed between Hawash, the Abai (Nile) and the Omo or Ghibie. The explorer went to Kiffan in the Kingdom of Gomma, and accompanied the king to Giren the capital, and to the summit of Mount Maiguddö (3,300 m.) whence the mountains of Culld, Centab, Aruzulla, etc., were seen and their positions ascertained. He then went to the Peak of Ali, to the market Cornbi, and to the cascade of the Ghibie, 40 metres high. Then traversing the desert between Gimma and Giangerò, he attempted to visit Mount Borguda where it is said that human sacrifices are offered on the first of every month but was attacked by the lancemen of Giangerò, and compelled to fly. Afterwards he visited the river Omo with the idea of passing south of the town of Vallamo to Cuccia, but was hindered by the king of Gimma. Another attempt to reach Borguda was defeated by the Giangerò, so, traversing the country of Abalti, he entered that of the Daddalé, and then returned to Antoto, whence he started for Zeila on the 9th October last.

The Giangerò are neither Musselmen nor Christians, yet adore a single spiritual indefinable god, to whom they sacrifice with knives at the first moon of every month 47 males who always belong to two honored families. All the Giangerò, by an operation performed when young, have but one testicle, and cut their hair that they may not appear women.

The river Omo does not turn to the east, as shown on all maps, but at 5° N. lat., bends westward and then turning southward falls into a lake or rather extensive marsh, known as Sciambara. This information was derived by Sir Borelli, from the testimony of more than 100 merchants in the habit of traversing the country in caravans. These merchants also asserted that the Omo leaves Lake Sciambara at its southern extremity, and ends by sinking under ground near a very large lake, which Borelli believes to be the Victoria. Thus the Omo may be the true source of the White Nile.

[1] This department is edited by W. N. Lockington, Philadelphia.

EUROPE; THE KOPIAS SEE.—HERR SUPAN (Petermann's Mitteilungen III. 1889.)—gives an account of the Kopias See, in the Bæotian mountains of Greece, and of the works undertaken since 1883 by the engineer Pochet for its reclamation In the above mentioned mountains are three basins, the Kopias, Likeri and Paralimni, all of which are permanenly or periodically filled by lakes which drain into the sea through the earth. The largest of these is the Kopias See which extends northward in two bays and westward is continuous with the wide valley of the Kephissos. Near the edge of this lake and not above twenty metres above its level, lie the ruins of Thebes and Livadia. The Kephissos and many other streams fall into these basins, and as the rainfall of the region varies greatly at different seasons and in different years, so does the level of the waters of the lake, thus banishing cultivation from any spot within several metres in height of the lowest level. In 1852 and 1864 even the ruins of Livadia were covered. Yet in the oldest period of Grecian history the kingdom of Minyas with its capital Orchomenos, occupied the sight of the Kopias, and in three spots traces of the canals and other works made to control the waters may be seen. The modern works consist of a ring-canal and an inner canal. These canals unite in the eastern bay of the lake, and the united canal is carried by a succession of cuttings and tunnels through the Likeri and Paralimini lakes into the sea.

GEOGRAPHICAL NEWS.—The greatest known depths of the various oceans are thus given by Dr. Supan (Petermann's Mitteilungen, III. 1889).

North Pacific Ocean	44° 55′ N. lat.	152° 26′ W. long.	8513 metres.
South Pacific "	24° 37′ S. "	175° 0 W. "	8101 "
North Atlantic Ocean	19° 39′ N. "	66° 26′ W. "	8341 "
South Atlantic "	0 11″ S. "	18° 15′ W. "	7370 "
Indian Ocean	9° 18″ S. "	105° 28′ E. "	5852 "

THE archives of Savona, a city not far to the west of Genoa, Italy, prove that the family of Christopher Columbus lived at that city about 1470.

AT the coming Paris Exhibition there is a globe 40 metres in circumference, that is, upon a one-millionth scale. All the regions will thus be represented with their correct curvature. This globe will not be so large as that of Mr. Wyld, which for a long time disfigured Leicester Square, London, but will have

the advantage in truthfulness, since Mr. Wyld's globe showed the various countries upon the interior surface, and therefore with a concave instead of a convex curvature.

OUT of the total population of 46,855,704 of the German Empire on Dec. 1, 1885, 22,933,664 were males and 23,922,040 females. As regards religion 29,369,847 were returned as evangelicals, 16,785,734 as Catholics, 563,172 as Israelites, and 125,673 as of other Christian creeds.

THE population of Bulgaria and Roumelia on January 1, 1888 was found to be 3,154,375, including the Russians, Servians, Germans, French, etc., sojourning in the country. The Bulgarian race includes 2,336,250 individuals. The Turks in the two countries number 904,000, with a curious predominance of the feminine sex, which counts 607,000. The same preponderance of females is observable in the Greeks, who number 56,000 females against 28,000 males. Among the Bulgarians and other races the male sex is in excess.

SOUNDINGS recently taken from the English ship Rambler in the Chushan archipelago near the Chinese coast, have proved the existence of submarine rocks which rise to a metre or even half a metre of the surface. These lie between 30°-3′-25″ and 30°-21′ N. lat, and 122°-12″ and 122°-25′25″ E. longitude.

BRITISH NEW GUINEA is divided into three sections, a western, from the Dutch boundary to the river Aixd, a central extending from the Aixd to the island of London in about 144°-15′ E. long. and an eastern which includes all the Lyonisiades to Rossel. A recent report of Sir John Douglas gives an account of all recent explorations.

IN his account of his ascent of Mount Kibo (Kilimanjaro) Otto E. Ehlers states that the tracks of an elephant were visible in the snow at a height of 5,000 metres together with tracks of buffaloes and antelopes. The last traces of vegetation were also found at the same elevation, (*Petermann's Mitteilungen*, III. 1889).

ASIA.—THE PRESENT FLORA OF KRAKATOA.—M. Treub, who arrived at Krakatoa, June 19, 1886, gathered near the

coast the seeds or fruits of sixteen species of plants, and upon the mountain, eight species of flowering plants, and eleven of ferns. Four of the phanerogams were composites. When it is remembered that all plants previously existing upon the island perished in consequence of the heat of the eruption, and that the whole island was at that date covered with a thick layer of scoria, the existence of a new flora is surprising proof of the part played in plant-colonization by currents, wind, and birds. All the species found upon the coast, except *Gymnothrix elegans*, a grass which is very common in Java, are identical with those colonizing species which are found in recent coral islands. Only two of the mountain species were identical with those of the coast. As regards the number of individuals, M. Treub says, "three years after the eruption, the new flora of Krakatoa is composed almost entirely of ferns. The phanerogams occur insolated here and there." Yet the soil is not at all favorable in its composition for the growth of ferns, which have been preceded by two species of mosses and six of algæ, the decay of which has furnished aliment to the ferns which in their turn prepare the ground for the phanerogams.

THE ISLAND REUNION.—According to M. A. Blonde (*Bull. d. l. Sociéte dé Géographie*) the island of Bourbon, or, as it is now called Reunion, discovered in 1545 by the Portuguese Mascarenhas, and taken possession of by France in 1649, is of elliptical form, its greater axis running N.W. and S.E., and its greatest length and width being 71 and 57 kilometres respectively. The island is entirely volcanic, and seems to have been formed by a volcano originally situated at the N.W extremity, but which was displaced southward until it finally reached the S.E. extremity, where it is still in activity. The route of this volcano is marked by extinct craters ranged symmetrically on both sides of the axis, the principal those of Mufate, Ciloss, and Salazie. From these great circles spring the three great torrents of the island, the rivers Galets, St. Etienna, and Midi. These are separated by high mountains, among which are Grand-Beirard, 2,970 metres, Cimandef 2,250, Pitore de les Neiges, 3,069, and Salago, 2,150 m.

NEW GUINEA.—According to Prince Roland Bonaparte the share of Holland in New Guinea has an area of 382,000 sq. kilometres, that of England 230,000, and that of Germany 232,000. The last includes 52,000 sq. kil. of smaller islands,

which are now known as the Bismarck archipelago, while the German portion of the mainland has received the title of Kaiser Wilhelm-Land. Another brochure of the same writer gives maps of the Gulf of Huen (New Guinea), according to Fleuriece, D'Entrecasteaux, and Mosely, also a corrected map from the recent explorations of Finsch and Von Schweinitz.

CAPT. BINGER'S JOURNEY.—Capt. Binger, who, two years ago, undertook a journey of exploration from Bamaka towards the Gold Coast, has been heard from, his last letter being dated Salagha, Dec. 11, 1888. M. Binger encountered great difficulty in leaving the territory of Lamery. It was his proposition to study carefully the mountains whence the Joliba takes its source, and it was arranged that so soon as he gave notice of his arrival at Kong, a victualling party should march along the Akka from Grand-Bassam to relieve him. In March, 1888, M. Binger reached Kong. From Kong, M. Binger proposed to make an excursion to Xendi, returning to Kong by the Gottogo. The French residents of the Slave Coast, having heard of the arrival of a white man at Salagha, sent a messenger to him, who brought back an answer in which M. Binger stated that, leaving Salagha the next day and, repassing Kong, he trusted to reach Grand-Bassam in April, 1889. The ease with which the communication was sent from the Slave Coast, (Grand Popo and Agoue) shows that Kong is more accessible from this part than from the Gold Coast.

GEOLOGY AND PALÆONTOLOGY.

AN INTERMEDIATE PLIOCENE FAUNA.—Mr. Geo. C. Duncan sent me a collection of remains of Mammalia from a lake deposit in Oregon which has an interesting character. The list of species is short, and but few of them are determinable. It is as follows:

Canis sp.
Elephas or *Mastodon*.
Holomeniscus or *Auchenia*.
Aphelops sp.
Hippotherium relictum sp. nov.
Equus sp.

These bones do not resemble in color those from near Silver Lake, Oregon, which are black. They are yellowish brown or light brown, like those from the locality in Whitman Co., which were recorded in the last number of the NATURALIST. The interest of the list consists in the fact, that it represents the first time a fauna which contains at the same time the large true horses and lamas, and the three-toed horses and Aphelops rhinoceros. The latter forms belong to the Loup Fork horizon, and the former to the Pliocene, and they have not been found hitherto in association in the Rocky Mountain Region. The fauna described from Florida, by Leidy, is probably of Loup Fork or Upper Miocene age, and the mammalia are similar to or identical with those of the same horizon in Kansas and Nebraska.

This fauna represents an older period than the Upper Pliocene of Silver Lake, and may be, very probably, the contemporary of that of the Pliocene lake of Idaho, from which I have described numerous species of fresh-water fishes. The deposits containing them I called the Idaho beds (Proceedings Academy Philadelphia, 1883 p. 153), and they may be regarded as representing the middle or lower Pliocene. The new Hippotherium is characterized as follows:

Represented by two superior and three inferior molar teeth. The grinding surface is nearly square, and the crown is short, and moderately curved. The section of the internal style is a wide oval, and it presents no angle or point of approximation to the protoconic crescent, and conversely none to the posterior column. The latter has the usual connection with the hypoconic crescent, but projects as far inwards as the anterior area, and is well defined. The enamel-boundaries are quite simple. The usual loop of the posterior inner border of the anterior lake is rudimental in an anterior true molar, and in the last molar it is small and subround. No isolated loop. A single short process of the border towards the internal column. Cementum abundant.

Dimensions of superior molars, No. 1; diameters of grindface; transverse, 19 mm.; anteroposterior, 16 mm. No. 2; transverse, 19 mm.; anteroposterior, 18 mm.—*E. D. Cope.*

STORMS ON THE ADHESIVE DISK OF ECHENEIS.—In a paper published in the *Annals and Magazine of Natural History* for July, 1883, Mr. Storms endeavors to solve the different questions pertaining to the structure and morphological inter-

pretation of the adhesive disk of Echeneis, and closes with the following remarks suggested by *Echeneis glaronensis*:

"1. As to the position in classification of the genus Echeneis;

"2. As to the general form of the body of *Echeneis glaronensis* as compared with that of living species.

"1. Authors have classed this genus in various families of Acanthopterygians. Joh. Müller makes of it a group of the Gobiidae; L. Agassiz and, after him, most authors class them with the Scombridæ.

"Certainly none of the characters of *Echeneis glaronensis* point toward the Gobiidæ; on the contrary, in the shape of the head, the structure of the ventrals, the size of the pectorals, the shape of the caudal fin, etc., it differs more from the Gobiidæ than the living forms do. On the other hand, by all these characters and others, *Echeneis glaronesis* ought to be classed among the Cotto-Scombriform Acanthopterygians. But here the difficulty begins. If we adhere strictly to the characters of the families given by Dr Günther, *Echeneis glaronensis*, on account of the number of its vertebræ (10+13 according to Dr. Wettstein,) should be classed among the Carangidæ, whilst all the living forms having more than 10+14 vertebræ ought to be put with the Scombridæ. The other characters of *Echeneis glaronensis* do not determine in which of the two families it ought to be placed.

"2. A careful comparison of the proportions of all the parts of the skeleton of the fossil Echeneis with those of the living forms, such as *Echeneis naucrates* or *Echeneis remora*, shows that the fossil differs nearly equally from both, and that it was a more normally shaped fish than either of these forms. The head was narrower and less flattened, the preoperculum wider, its two jaws had nearly the same length. The ribs, as also the neural and hæmal spines, were longer, the tail more forked, and the soft dorsal fin much longer. In fact it was a more compressed type, probably a far better swimmer than its living congeners, as might be expected, if the smallness of the adhesive disk is taken into account."

It is evident from the above description of Dr. Storms that the *Echeneis glaronensis* represents a genus distinct from the existing forms of the family. This new genus may be named Opisthomyzon, from the fact that the sucking disc is more posterior in position than in the living forms.—*E. D. Cope.*

SKETCH OF THE GEOLOGY OF SPAIN.—The *Reseña Geographica y Estadistica* of Spain, issued during the past year, contains an introductory article upon the geology of the peninsula by D. Juan Bisso. During the Cambrian age the surface of Spain presented a multitude of isles and islets, composed in great portion of igneous rocks, but containing also stratified crystalline strata. The principal island, already quite extensive, occupied the greater part of Galicia, the north of Portugal and small portions of the present provinces of Caceres, Salamanca, and Zamora. Another isle occupied the eastern portion of the present Castilian provinces of Avila, Segovia, and Toledo. A great number of islets were strewn in what is now the southern part of Portugal, Estremadura, and north-western Andalucia. Toward the North arose some points in the line which eventually became the northern Cordillera. Later on, at the close of the Cambrian, the important slate deposits of the Pyrenees arose above sea-level, together with portions of Estremadura, and of the southern Andalucian mountains.

Throughout the Silurian and Devonian periods the main island increased considerably, so that at the commencement of the Carboniferous, it occupied all Galicia, the west of Asturias, and the provinces of Leon and Zamora, its southern line running by Ledesma, Salamanca, Sepulveda, and Siguenza, and then turning south in an irregular curve so as to embrace, in the same mass, the sites of Madrid, Toledo, Cuidad Real and Alcarez. Its most southerly extension reached the Sierra Morena, and its western coast extended to Oporto. At the same period a great part of the Pyrenees had emerged, as well as many islands, in Catalonia, between Burgos and Soria, in western Aragon and eastern Castile. In the south parts of the Sierra Nevada and the extreme south-east of the peninsula had appeared. Permian strata have not been, with certainty, met with in Spain.

In the Triassic period the principal mass already extended much to the southeast, and in Portugal and Huelva had almost reached its present limits, comprehending Seville and Cordova in its southern extension. In the northeastern it occupied all of Oviedo and Leon, Zamora and Salamanca, great part of the provinces of Valencia and Santander. The Pyrenees formed a zone as now; almost all the southeastern islands united forming a tract occupying great part of the present provinces of Murcia, Almeria, Granada and Malaga.

The Jurassic seas must have occupied but a small extent, since at the conclusion of the Triassic, the greater part of

the present peninsula had emerged, including part of the Basque provinces, eastern Castile and northern Andalucia, while the remainder of Andalucia was occupied by many islands.

Subsequent submergence made the Cretaceous seas larger,the eastern coast of the principal mass receding to the line of Santander, Reinosa, Burgos and Segovia, while a gulf extended in the north from Santander almost to Oviedo, and the Pyrenees were partly submerged. Yet in the same period the islands of Aragon and the eastern part of Castile became united into a peninsula, joined to the mainland by a narrow Isthmus at Avilar. This peninsula extended southward to the Sierra Albarracin. At the same time the islands between Burgos and Calatayud became united into one, those along the coast from Gerona to Fortora also joined, and those of Murcia became united to the great southeastern island.

At the end of the Cretaceous period the peninsula was completed almost as it now stands, except that the sea covered the entire basin of the Ebro, penetrating between the islands of the coast from Gerona to Murcia (again partially submerged) and through passes opened in the Pyrenees. There was also a narrow lake in the center of Galicia. During this period immense nummulitic deposits accumulated in the Ebro basin, until the sea finally shallowed into a series of lakes, which in Eocene times filled up with a different series of deposits.

In Miocene times, the sea penetrated only between the Murcian and Andalucian islands, into the basin of the Guadalquivir, in the north at some points in Galacia, and along a narrow zone on the eastern coast. Lakes still existed in the basin of the Ebro, and also through most of the provinces of the Castilles and Leon. In Portugal a number of smaller lakes occupied much of the area about Leiria, Lisboa, Evora and Castro-Verde.

In the Pliocene age the sea still penetrated by various points, especially into the valley bed of the Guadalquiver. Many small deposits occur in the valleys. All that the Post-pliocene has done has been to fill up various depressions with extensive diluvial and alluvial deposits.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—The serpentine of Montville, N. J., occurs in veins and as isolated nodules in crystalline dolomite, and also as a thin coating on irregularly rounded masses of a gray crystalline pyroxene, with the chemical and optical properties of diopside. The examination of thin sections across the contact between the enclosing serpentine and its nucleus of pyroxene shows conclusively that the former is the direct product of alteration of the latter. In almost all cases the resulting serpentine is found to be slickensided and grooved as if it had been shoved along against some hard substance, and had thereby suffered planing. The origin of the pressure producing this shoving is thought by Mr. Merrill[2] to be the increase in volume which the pyroxene undergoes in its change to serpentine. Even when the alteration is complete and no trace of the original pyroxene remains, the origin of the serpentine through the hydration of some magnesium mineral is shown by the crowding of the calcite grains associated with the serpentine into broad fan-shaped masses. Analyses of the pyroxene core and serpentine surrounding it substantiate the conclusions reached by the microscopic study of thin sections.

	SiO_2	MgO	CaO.	Al_2O_3	Fe_2O_3	FeO	Ign.
Pyroxene	54.22	19.82	24.71	.59	.20	.27	.14
Serpentine	42.38	42.14		.07	.97	.17	14.12

From the fact that no veins of quartz are to be found in the serpentine, it is thought that sufficient magnesium was furnished by the dolomite to change all of the silica of the pyroxene into serpentine.—The ophiolite from Thurman, Warren Co., N. Y., is observed by the same author[3] to have originated in the same manner as the serpentine from Montville. In this case, however, the original pyroxene occurs in little grains and concretionary masses scattered through calcite.—The rocks to the north of Lake Bolsena in Italy consist principally of trachytes, according to Klein,[4] and those to the south of a leucite bearing series. The former include olivinitic and non-olivinitic varieties in different members which the amount of plagioclase varies largely. The leucite rocks embrace tephrites, basanites and leucitophyres. The first two contain porphy-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2] Proc. U. S. Nat. Museum. 1888. p. 105.
[3] Amer. Jour. Sci. March. 1889. p. 189.
[4] Neue Jahrb f. Min., etc., B. B. vi p. 1.

ritic crystals of leucite, augite, plagioclase, sanidine, magnetite, apatite, hauyne, nepheline and more or less olivine in a groundmass composed of microlites of leucite, augite and plagioclase, and a very little glass. According to the predominance of one or the other of the constituents they are divided into basaltic, doleritic and tephritic varieties, and these are further subdivided into olivinitic and non-olivinitic sub-varieties. To the northeast of the Lake there is an augite-andesite with a zonal plagioclase in which the different zones possess very different extinction angles. The paper in which these rocks are described contains a fine series of analyses.—An interesting occurrence of basic concretions in the granite of Mullaghderg, County Donegal, Ireland, is described by Hatch.[1] The rock is a dark, coarse-grained, sphene-bearing, hornblende-granitite containing microcline, orthoclase and oligoclase. Sections of orthoclase nearly parallel to the orthopinacoid are traversed by two sets of strongly refracting markings parallel to the cleavage lines. The markings are due to the deposition of a mineral with an extinction of 14° in the formerly existing cleavage cracks. In this granite are flattened spheroids of three or four inches in diameter, which consist of a reddish granite nucleus and a zonally and radially developed periphery composed of plagioclase, magnetite and a little brown mica. A resumè of the literature of spheroidal granites is given and a classification of the spheroids is attempted.—A second[2] paper on the dyke rocks of Anglesey is occupied with a description of the diabases and diabase porphyrites of the islands of Anglesey and Holyhead, England. A hornblende-diabase from a large dyke running along the east side of Holyhead Mountain contains a large amount of apatite, and augite crystals that have been enlarged by the addition of original hornblende material.[3]—Dr. Bonney[4] regards the isolated masses of green sandstone occurring in the sand pits near Ightham in Kent, England, as having originated *in situ* by concretionary action. The individual grains are connected together by chalcedony and quartz, the latter forming a fringe around each one of the grains and the latter filling in the remaining interstices.—Dr. Hatch[5] records the analysis of a micrograniti keratophyre from near Rathdrum, County Wicklow, Ireland.

[1] Quart. Jour. Geol. Soc. 1888. p. 548.
[2] Cf. AMERICAN NATURALIST, 1888. p. 453.
[3] Harker: Geol. Magazine, 1888. p. 267.
[4] Geol. Magazine, 1888. p. 297.
[5] Geol. Magazine, Feb. 1889. p. 70.

The rock consists almost exclusively of a microcrystalline groundmass of quartz and albite in which are a few porphyritic crystals of the latter mineral. These are sometimes broken up into patches divided by narrow seams of feldspathic substance with an extinction different from that of the albite. The analysis yielded:

SiO_2	Al_2O_3 Fe_2O_3	CaO	MgO	K_2O	Na_2O	Ign.
77.29	14.62	tr	.38	.16	7.60	.57

—Gonnard[1] mentions pyrite, oligoclase, emerald, garnet, beryl, calcite, chlorophyllite, apatite and tourmaline as accessory constituents of the gneiss occurring along the banks of the Saône near Lyons, France.—Kloos[2] has examined the thin sections of rocks that have been subjected to great artificial pressure, and finds in them no signs of mineral crushing. He advises care in ascribing to pressure the crushed appearance of minerals in rocks. He is inclined to regard the phenomenon as due to increase in volume under chemical change.—A typical picrite occurring in boulders near St. Germans in the Liskeard District in Cornwall, England, is mentioned by Bonney[3] as containing augite which has been changed successively into brown and green hornblende, and colorless needles of the same mineral, while the original form of the augite has remained. —Glaucophane has been discovered by the same author[4] as a secondary product of augite in a diabase occurring in a block in the Val Chisone, Cottian Alps.—Aggregates of topaz, a little feldspar, kaolin and mica have been found by Salomon[5] in a granular quartz rock (one variety of the greisen) resulting from the silicification of the granite at Geyer in Saxony.—The green-sand from just above the chalk beds in Kent, England, is composed[6] of grains of quartz, flint, feldspar, glauconite, magnetite, spinel, zircon, rutile, tourmaline and occasional grains of garnet, actinolite, epidote and chalcedony.—An eclogite from near Frankenstein in Silesia consists essentially[7] of omphacite and a calcium garnet. The omphacite contains inclusions of smaragdite, and portions of the garnet have passed over into zoisite through the loss of calcium and the assumption of water.

[1] Bull. Soc. Franç. d. Min. XII. p. 10.
[2] Zeits. d. deutsch. geol. Gesell. XL. 1888. p. 612.
[3] Min Magazine, Oct. 1888. p. 108.
[4] Min. Magazine, Dec. 1887. p. 191.
[5] Zeits. d. deutsch. geol. Gesell. XL. p. 570.
[6] Miss. Gardiner: Quart. Jour. Geol. Soc. Nov. 1888. p. 755.
[7] Traube: Neues Jahrb. f. Miner., etc. 1889. I. p. 195.

MINERALOGICAL NEWS.—*New Minerals.*—*Dahllite*[1] occurs as a yellowish white incrustation on red apatite from the Odegärden mine at Bamle, Norway. It is found in little fibres with a density of 3.053 and a composition as follows:

CaO	FeO	Na_2O	K_2O	P_2O_5	CO_2	H_2O
53.00	.79	.89	.11	38.44	6.29	1.37

corresponding to $4\,(Ca, Fe, Na_2, K_2)_3\,(PO_4)_2 + 2\,Ca\,CO_3 + H_2O$. Before the blowpipe the mineral decrepitates without fusing. It is uniaxial and negative.—*Eudidymite*[2] is found in tabular crystals in the elaeolite syenite of Langesundfjord at Aro, Norway. It is a white mineral with an easy basal cleavage, a hardness of 6, and specific gravity of 2.553. It is minoclinic with $a : b : c = 1.7107 : 1 : 1.1071$ and $\beta = 86° 14' 27''$. The plane of its optical axis is the clinopinacoid. The acute bisectrix is inclined 58½° to c in the acute angle β. $2Va = 29° 55'$ for yellow light, and the dispersion is inclined with $\rho > \upsilon$ Its analysis yielded:

SiO_2	BeO	Na_2O	H_2O	
72.19	11.15	12.66	3.84,	corresponding

to $Na.\ H.\ Be.\ Si_3\ O_8$.

—*Lansfordite* is a white mineral resembling calcite. It is described by Genth[3] as forming stalactites 20 mm. in length in an anthracite coal mine at Lansford, Schuylkill Co., Pa. Its composition is $MgO = 23.18$ per cent, $CO_2 = 18.90$ per cent, $H_2O = 57.79$ per cent, $= 3\,MgCO_3 + Mg\,(OH)_2 + 2\,H_2O$. Its hardness is 2.5, and specific gravity 1.692.—*Rare Minerals.*—Messrs. Diller[4] and Whitfield have identified the blue mineral present in fibres penetrating the quartz and plagioclase of the pegmatoid portion of a biotite gneiss at Harlem, N. Y., as *dumortierite*. In thin section the mineral is seen to have a cleavage parallel to $\infty P\bar{\infty}$ and a second parallel to some prismatic plane. It contains long tubular cavities parallel to the vertical axis and is frequently polysynthetically twinned parallel to some plane in the prismatic zone. It has a hardness of 7, and specific gravity of 3.265. The analysis of a specimen of the mineral obtained from a rock composed principally of dumortierite and quartz, from Clip, Arizona, yielded:

[1] Brögger and Bäckström: Oefv. af. Kongl. Vetenskaps Akad. Förh. Stockholm. 1888. No. 7.
[2] Brögger: Nyt Magazin for Naturv. XXX. II. p. 196.
[3] Genth: Zeits. f. Kryst. XIV. p. 255.
[4] Amer. Jour. Sci. Mch. 1889. p. 216.

SiO_2	Al_2O_3	MgO	B_2O_3	P_2O_5	H_2O
27.99	64.49	tr.	4.95	.20	1.72

equivalent to $3\ Al_4\ Si_3O_{12} + Al\,(BO_3)_3 + 2\ H_2O$. Damour,[1] who first analysed the mineral regarded it as a simple silicate of aluminuium of the formula $Al_8\ Si_3\ O_{18}$.—Additional observations upon *bertrandite* increase materially our knowledge of this rare mineral. Investigations by Urba[2] upon the crystals coating the faces of feldspar from Pisek, Bohemia, and the walls of cavities in this mineral yield results analogous to those obtained by Penfield[3] in the case of the Mt. Antero crystals. According to Urba $a : b : c = 7191 : 1 : 4206$. In addition to the cleavage parallel to $3\bar{P}\bar{\infty}$ Urba finds also a very perfect one parallel to oP. The new plane $\frac{4}{9}\ \breve{P}\breve{\infty}$ is also discovered. Analysis of the Pisek mineral gave: SiO_2=49.90, BeO=42.62, H_2O=7.94. The Mt. Antero crystals[4] are bounded by the three pinacoids. Of the two basal planes one is flat and the other rounded in consequence of an oscillatory combination with a brachydome. The distribution of the electrical properties of the crystals show them to be hemimorphic, as indicated by the oscillatory combination on one only of the basal planes. The mineral has recently been discovered at Stoneham, Maine. Mr. Penfield[5] has examined crystals from this locality and has identified on them the planes oP, $\frac{1}{2}\ \bar{P}\bar{\infty}$, $3\ \breve{P}\breve{\infty}$, $\infty\breve{P}\breve{\infty}$, and $\infty\ \breve{P}3$. The crystals are double wedge-shaped, are hemimorphic in the direction of their vertical axis, and are elongated parallel to the brachy-axis. One twin with oP as the twinning plane was observed. A calculation of the axial ratio gave $a : b : c = .5973 : 1 : .5688$.—Pisani[6] has analysed *cupro-descloizite* from Zacatecas, Mexico and has found in it:

Vd_2O_5	As_2O_5	PbO	CunO	ZnO	H_2O
17.40	4.78	53.90	8.80	11.40	3.20

The mineral has a brown color on a fresh fracture, and a specific gravity of 6.06.—A new analysis of the very remarkable mineral *melanophlogite* has been made by Pisani.[7] The mineral was found in little colorless cubes associated with calcite, sulphur and celestite in a limestone geode from near Girgenti, Sicily. After purifying as carefully as possible it yielded:

[1] Bull. Soc. Min. d. France. IV. p. 6.
[2] Zeits. f. Kryst. XV. p. 194.
[3] Cf. AMERICAN NATURALIST. 1888. p. 1023.
[4] Penfield. Amer. Jour. Sci., Mch. 1889. p. 210.
[5] Ib. p. 210.
[6] Bull. Soc. Franç. d. Min. XII. p. 38.
[7] Bull. Soc. Franç. d. Min. Dec. 1888 XI. p 298.

SiO_2	SO_3	Fe_2O_3 Al_2O_3	Loss.
91.12	5.30	.43	1.52.

—*Kröhnkite* ($Cu\,SO_4 + Na_2\,SO_4 + 2\,H_2O$) from Chili, is monoclinic, according to Darapsky[1] with $a:\ b:\ c = 1:\ 2.112:\ 0.649$. B $=64°\ 8'$. Its hardness is 2.5, and specific gravity, 1.98.

BOTANY.[2]

THE TREATMENT OF EXSICCATI IN THE HERBARIUM.—Whether exsiccati should be kept as they are published, or cut up and distributed in the Herbarium, is a question of sufficient importance, it seems to me, to warrant a brief consideration. Exsiccati are generally arranged arbitrarily, and unless well indexed, are often labyrinths to those who are unfamiliar with them. Those which have a separate index to each fasciculus are bad enough, but, unfortunately, many of the largest and best sets have no index at all, and those whose indexes are published separately are continually outgrowing them. If distributed in the herbarium, the specimens are always at hand, and a student does not need to examine indexes to see whether a given species is in such or such a set, but can find all the specimens from every set together in the herbarium, thus saving time and patience, and making comparison of specimens more easy. Much of the synonomy becomes in time forgotten and obsolete, and many exsiccati are for this reason almost useless. But if distributed, the synonomy of each specimen can be kept up with the times by means of labels on the sheet on which it is mounted, and thus many specimens made useful which otherwise would be of but little value for reference.

The common objection to cutting up and distributing exsiccati is that it destroys their identity. But in most exsiccati the name, etc., is printed on the label of each specimen, and if not, these labels can easily be stamped. References to exsiccati are, as a rule, by number, but if distributed, the specimens can be found by name without the number, and when found the number is with them to show that they are the specimens referred to. Besides, if distributed, they can be found by many who have not noticed these references.

[1] Neues Jahrb. f. Min., etc. 1889. I. p. 192.
[2] This department is edited by Professor Charles E. Bessey, Lincoln, Neb.

A strong objection, however, to cutting up exsiccati is found in cases where species are described in them, and the exact dates of the descriptions are wanted. These dates are generally given on the covers of the fasciculi, and are, of course, lost if the set is cut up and the specimens distributed. This can be partially remedied by preserving these covers, as the number of each specimen will indicate to which one it belongs; and this one objection is certainly overcome by the manifest advantages of wider usefulness, greater convenience of reference, and saving of time otherwise spent in determining synonomy.—*Roscoe Pound.*

ANEMONE CYLINDRICA GR. WITH INVOLUCELS.—Last year, in running over some Nebraska plants from Lincoln, with Mr. Pound, we noticed undoubted specimens of *Anemone cylindrica* Gr., with one or two peduncles bearing two leaved involucels. Further examination of numerous specimens collected in the same vicinity at different times shows this peculiar feature to be of quite common occurrence. The leaves of the involucels are similar to those of the involucre.

Authors, in characterizing this species, describe the peduncles as naked; it is remarkable, then, that this peculiarity should occur so commonly.

It may be a hybrid with *A. dichotoma* L., which is provided with an involucel, and occurs here commonly.—*H. J. Webber.*

POLYGONUM INCARNATUM ELL. WITH FOUR-PARTED PERIANTH.—A form of *Polygonum incarnatum* Ell. is found commonly in the vicinity of Lincoln, Neb., having the perianth four-parted instead of five-parted as always described. On most heads, however, a few flowers may be found having the normal five sepals. *P. incarnatum* belongs to the section Persicaria Tourn., characterized as having a five-parted perianth. *P. virginianum* L., belonging to the section Tovaria Adans., which has the perianth four-parted, is found in the same vicinity. It is the *only* other four-sepaled species occurring.—*H. J. Webber.*

INFECTION OF THE BARBERRY; HOW PERFORMED.—Let us suppose that we wish to perform the classical infection of the barberry with *Puccinia graminis*. In the autumn, six young barberries, small enough to be covered with a bell-glass, having been planted, as soon as their leaves are fully developed in the spring, they may be infected in the following manner: A quantity of *Puccinia graminis* having also been provided in the autumn, and kept during the winter in

the mode before explained,[1] as soon as the barberry foliage is ready, test the germination power of the *P. graminis* by placing a few fragments in water in a watch-glass. If it germinate freely and produce a good crop of mycelical spores, as proved by microscopic examination, the contents of the watch-glass may be at once employed. It is best to do your infection experiments in the evening. Water one of the barberries freely, through the nose of a watering-can, and then cover it with a bell-glass ; then water the outside of the bell-glass. By so doing, the temperature of the enclosed air is reduced, and the inside of the bell-glass, as well as the leaves of the barberry become bedewed with condensed vapor. After leaving it a few minutes, remove the bell-glass and apply the germinating spores with a camel-hair pencil. As the promycelial spores easily become diffused in the water in the watch-glass, by stirring it with the camel-hair pencil the water becomes equally charged with them ; then by simply brushing the water on the leaves you may be pretty sure of successfully infecting the plant. Replace the bell-glass and give it another douching outside with the watering-can. If sufficient material has been prepared, each alternate barberry may be infected in the same manner. The bell-glass need not be kept over the infected plants more than two or three days. If the weather be very bright, the bell-glasses should be shaded by putting a piece of matting or carpet over them to prevent the foliage being scorched by the sun. In the course of eight or ten days the yellow spots, on which the spermogonia are produced will appear, and in two or three weeks the perfect æcidiospores will be developed. It will then be seen that only those barberries to which the spores were applied have the æcidiospores on them, while the alternate plants remain free. If an attempt be made to infect a plant in the daytime, when the sun's rays are full upon it, it will be found that the water all runs off the leaves ; but by operating in the evening, in the manner directed, the leaves are bedewed with a thin layer of moisture, and no difficulty will be found in applying the spore-charged water.—*C. B. Plowright, in Monograph of Uredineæ and Ustilagineæ.*

A True Field Manual of Botany.—The publishers announce that they will bring out an edition of the new revision of "Gray's Manual," with narrow margins, and with limp cover binding, for field use. As this will bring the book

[1] Bundles of straw containing teleutospores are to be collected in the autumn, and kept out of doors during the winter, so that they may be subjected to the same vicissitudes of temperature and moisture as would happen to them in a state of nature.

down to a pocket size, every teacher ought to insist upon this edition for use in his botanizing classes. It is understood that the revision will include the plants of the prairies, and of the great plains up to the eastern limits of the region covered by "Coulter's Manual," *i. e.*, about the 100th meridian. —*Charles E. Bessey*.

DISTRIBUTION OF KANSAS FUNGI.—Dr. W. A. Kellerman and Mr. W. T. Swingle, well known mycological students of Manhattan, Kansas, have undertaken to make a distribution of Kansas fungi. The first fascicle consists of twenty-five species very neatly put up, with printed labels. The species represented are the following:

Aecidium aesculi E. & K. *Aecidium dicentrae* Trelease. *Ceratophorum uncinatum* (Clinton) Sacc. *Cercospora cucurbitae* E. & E. *Cercospora desmanthi* E. &. K. *Cercospora lateritia* Ell. & Halsted. *Cercospora seminalis* E. & E. *Gloeosporium apocryptum* E. & E. *Gloeosporium decipiens* E. & E. *Melasmia gleditschiae* E. & E. *Microsphaera quercina* (Schw.) Burrill. *Peronospora arthuri* Farlow. *Peronospora corydalis* DeBary. *Phragmidium speciosum* Fr. *Puccinia emaculata* Schw. *Puccinia schedonnardi* Kell. & Sw. *Puccinia* (*Leptopuccinia xanthii*) Schw. *Ramularia virgaureae* Thuem. *Roestelia pyrata* (Schw.) Thaxter. *Scolecotrichum maculicola* E. & K. *Septoria argophylla* E. & K. *Septoria speculariae* B. &. C. *Sphaerotheca phytoptophila* Kell & Sw. *Uredo quercus* Brondeau. *Ustilago zeae mays* (DC.) Winter.

ZOOLOGY.

THE NERVOUS SYSTEMS OF ANNELIDS AND VERTEBRATES.—Mr. John Beard analyzes in a recent number of *Nature* the Annelidan features found in the development of the Vertebrate nervous system, and adds some points of his own. He claims that the spinal ganglia arise not from the neural ridges but from the adjacent ectoderm, and in such a manner as to justify their comparison with the parapodial ganglia described by Kleinenberg in Lepadorhynchus. Again, the two halves of the neural plate are separated at an early stage by a median groove of ciliated epithelium, and therefore the nervous system is ontogenetically paired. This ciliated groove ultimately furnishes the epithelial lining of the neural

canal, and except the fact that in the annelids the ciliated groove is not invaginated, the resemblance is thus rendered very close.

THE ORIGIN OF THE VERTEBRATE PELVIS.[1]—Professor Weidersheim presents the following hypothesis of the origin of the Vertebrate pelvis. The *inscriptiones tendineæ* of the ventral myocommata which are immediately below the posterior limbs, develop cartilage, and unite on the middle line, forming the simple median pubis of the Lepidosirenidæ and of the Urodele Batrachia. In the Ceratodontidæ this pubis has a short lateral process which is directed upwards and backwards. In Lepidosirenidæ this process is much more elongate, and is derived from a metamorphosis of the tissue of the myocomma. At its distal (superior) end it passes into fibrous connective tissue. This is the cartilaginous beginning of the ilium, which in most Batrachia and in higher Vertebrata reaches the vertebral column.

A BOY WITH A TAIL.—The *Naturaliste*[2] gives a figure (from a photograph) and a description of a boy who lives near Saigon, who has a tail about eight inches long. It originates at the usual point, but contains no vertebræ. The extremity is bent outwards, like the horizontal part of a crank. The boy has also a mammiform enlargement on each buttock. He is about twelve years of age.

ZOOLOGICAL NEWS.—ECHINODERMS.—L. Cuénot (*Arch. Zool. Exp. et Gen.*, 1888) details the anatomy of several brittle stars. While many of his statements do not well admit of abstract, it may be noticed that he finds, not hæmoglobin as has been reported, but a colored ferment, which converts peptones into albuminoids.

Ludwig (*Zeitsch. wiss. Zool.*, xlvii, 1888) describes *Ophiopteron elegans*, a brittle star which apparently has the power of swimming ; while in the same number Brock has a revision of the Ophiurids of the Indian Archipelago.

WORMS.—Völtzkow (Semper's *Arbreten* viii.), investigates *Aspidogaster conchicola*, which is familiar as a type of the trematodes in Huxley's "Invertebrata." The egg undergoes total segmentation and is enclosed by a cellular membrane, as in other Trematoda. The penis, vulva, receptaculum vitelli,

[1] Bericht. d. Natu-forsch. Gess. Freiburg, i. e., Bd. IV., Heft. 3.
[2] No. 48, March, 1889.

etc., are ectodermic, but the internal generative organs are of mesodermic origin. The young forms pass into the stomach of the mussel, from which it works its way into the pericardium and kidneys of the host. The details of the adult structure are given.

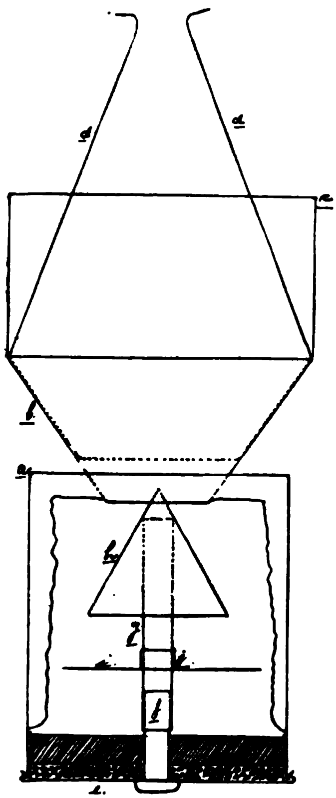
At the meeting of the Linnean Society of New South Wales, Nov. 28, 1888, Mr. J. J. Fletcher described twenty new species of Australian earthworms, twelve belonging to the genus *Cryptodrilus*.

MOLLUSCA.—The land-shell, *Subulina octona* Chem., hitherto regarded as peculiar to the West Indies, has been found in a coffee plantation in New Caledonia. Its introduction is as yet unexplained.

ENTOMOLOGY.

AN INSECT TRAP TO BE USED WITH THE ELECTRIC LIGHT.—Some experience in collecting insects at the electric lights last summer led me to the conclusion that a simple piece of apparatus, which could take the collector's place, when he was forced to go home to steal a few hours for sleep, would be a boon to the insect-hunter. Having once gained the idea I at once endeavored to realize it, with the following result:

I obtained a three-quart tin pail, represented by *a* in the accompanying drawing, about six and one-half inches long by five and a half in diameter, and had a tinner cut out of the bottom a three-inch circle. Then taking a funnel six inches and a half in diameter at its widest part my tinsmith cut off the smaller end so as to leave an opening at this end of two and a quarter inches in diameter. This frustrum of a hollow cone, *b* in the drawing, is then soldered fast to the bottom of the pail *a*, the flaring end being outward and the smaller end projecting within the pail a half inch or more. A flat, hexagonal piece of tin, *c*, was next made to fit the funnel, *b*, and, after being carefully adjusted so as to stand vertically across the center of the mouth of the funnel, was firmly soldered in this position. Two pieces, *dd*, of steel spring, No. 8 wire, were then fastened to opposite sides of the funnel. These wires when pressed together at the top will pass into the small opening in the bottom of the globe of the U. S. Electric Light Co.'s lamp, and when released from pressure will spring back to their normal po-



sition and the projecting ends will rest upon the inner surface of the globe, and thus furnish a means of support for the apparatus. The lid of the pail, *e*, which forms the bottom of the trap, has soldered to its inner face a cylindrical tube of two inches or a little less in length; between this tube and the rim of the lid is put first a layer of crystals of potassium cyanide and over this a half-inch layer of plaster of Paris, which should be carefully smoothed down and then moistened with sufficient water to form a hardened crust over the top a quarter of an inch or a little more in thickness. The lid will have to be supported in the mouth of the pail in some way similar to that illustrated by the working drawing. Finally, a cylindrical tube, *g*, four and one-half inches long is made just large enough to fit snugly over the tube, *f*, and a hollow cone, *h*, with a diameter of three and a height of two and one-half inches is fastened to its top. If it is thought desirable a disk, *i*, about four inches in diameter, with a collar, *j*, may be made to slide up and down the tube *g*.

The whole inside of this trap, except the lower face of the hollow cone, *h*, should be painted black to allow the prey as little light as possible to aid them in making their escape; and the cone, *c*, should be thickly pierced with small holes one inch from the top. It is also well to varnish both sides of the vertical plate, *c*, the inside of the funnel, *b*, and the upper surface of the hollow cone, *h*, to make "Facilis desensus Averni." I have substituted glass for tin in the plate, *c*, as this material is probably entirely invisible to insects, they are more likely to heedlessly dash against it, while they may flutter about the bright tin. But it is much more difficult to fasten to the fun-

nel than tin, is easily broken, and I have not been able to see that it is, in practice, superior to tin. Although the action of the trap seems simple enough it may not be amiss to add a few words on this point. The insects that cluster about the electric lights will dash against the vertical plate, *c*, and being unable to obtain a foot-hold easily either upon its surface or that of the funnel, they will be likely to find their way into the inside of the trap, where they are pretty certain to remain, being prevented from escaping by the deadly fumes of the potassium cyanide and the cone, *c*, whose polished lower surface lighted up by the holes mentioned above will attract them away from the single opening.

The disk, *i*, merely serves to keep a portion of the insects separate from the others while they are engaged in their desperate death struggles; it may, however, be farther utilized as a support for a coarse wire screen, which is not represented in the drawing. This screen will serve a useful purpose in allowing beetles and other small insects to escape through it to the bottom of the trap; in this way only can moths be preserved in a fit state for museum specimens. The tube, *g*, can be raised or lowered so as to more or less completely close the opening in the bottom of the funnel and thus shut out all insects larger than a certain size. My limited experience last summer with this trap convinced me that it was of little use for collecting *Lepidoptera*, as they were usually ruined by the *Coleoptera*, which are much less easily overcome by the poison used. I have not tried the wire screen mentioned above, however, and this modification may preserve a considerable number very well. It answers the desired end very well indeed, however, for all the other orders, and it is especially useful in collecting small *Hemiptera*, *Neuroptera*, *Diptera* and *Hymenoptera*. I have frequently found a pint or more of insects in the trap when I came to examine it in the morning after exposure for a whole night.

Many of the forms will of course occur in unwelcome abundance, and the task of looking over the whole mass carefully is no slight one but it pays. I have in a single night taken a few more than a hundred species, and in three consecutive nights as many as a hundred and fifty species, but I have no doubt but that this record can be easily broken if some of my experiment-loving brother or sister entomologists will follow the suggestions offered in this paper.—*Jerome McNeill.*

EMBRYOLOGY.[1]

THE QUADRATE PLACENTA OF SCIURUS HUDSONIUS; OR, THE COMMON RED SQUIRREL.—In 1887, the present writer called attention to the existence of certain vestigiary placental structures developed during the early stages of the mouse, rat and field-mouse, which indicated that the discoidal placental disk of the late stages of fœtal life of these forms had been derived from one, the placenta of which was zonary or girdle-like in form, as in the cat, dog, hyrax, elephant, etc. All of the forms of rodents mentioned, however, possess at a late stage a very distinctly discoidal placenta, the development of which seems to be associated with the so-called *inversion of the germ layers*, which is so marked a feature of their ontogeny, and one also which renders its processes amongst the most specialized and complex known to embryologists. The notice published in September, 1887, as to the persistence of a girdle-like vestige of the decidua continuous with opposite sides of the placental disk, afforded only tentative evidence of the derivation of the discoidal placental from the zonary form. Recently some remarkably conclusive evidence, favoring such a view, has fallen under my observation in fœtuses of the common red squirrel. Mr. J. P. Moore, one of the pupils in the biological laboratory of the University of Pennsylvania, during the latter part of March, brought in a gravid female red squirrel in which two fœtuses were found, *in utero*, which are the basis of the following account.

These fœtuses measured 16 mm. in length from the vertex of the head to the end of the body. The two cerebral vesicels had just appeared as a pair of smooth saccular diverticula from the sides of the anterior end of the neural tube. The spinal cord filled out the vertebral canal entirely, and the two enlargements, brachial and lumbar, were distinctly visible through the integument of the dorsal median line. The limbs were so far developed as to show the digits distinctly differentiated. The stage, in fact, represents one which is very nearly equivalent to that of the human embryo at three months.

The peculiarity of the most importance in the present case, in relation to the question of the origin of the discoidal placenta in other forms, is the unusual shape presented by that organ, which is quadrate in *Sciurus hudsonius*. Both fœtuses

[1] This department is edited by Professor JOHN A. RYDER, University of Pennsylvania, Philadelphia.

were found in one horn. They formed ovoidal swellings of the uterine cornu separated from each other by a slight interval. They were nearly an inch long and not quite three-fourths of an inch in diameter. Upon carefully inserting the point of a scissors through the uterine wall ventrally, and opening it so as to expose the embryo in its membranes, it was found that the latter were not adherent to the mucosa, except over a small quadrate area on the mesometric side. After the placenta was forcibly detached with part of its decidua, the scar left on the uterine wall measured 9 mm. in length over its short diameter which coincides with the direction of the passage in the cornu. Its diameter the other way or transversely to the uterine cornu was 12 mm. The edges of the scar forming its short diameter were slightly elevated so as to form a pair of slight folds projecting above the non-placental area above and below the embryo. These folds represent a very rudimentary decidua reflexa, traces of which are also present in forms with a zonary placentation. The edges of the scar forming the margins of its long diameter pass gradually into the mucous membrane of the uterine walls, and there is no such well-marked fold representing a reflexa as appears on the other sides. The peculiar quadrate form of the placenta was equally manifest in its fœtal part, or that to which the umbilical cord and membranes are attached. The area of the placenta in millimetres is, in round numbers, $9 \times 12 = 108$ sq. mm. Over all the remaining portions the fœtal membranes were not attached to the uterine mucosa. There was a strongly developed *decidua vera* over the placental area.

If we now compare this peculiar quadrate placenta with the ordinary zonary type the homologies of its parts will become clear, and I think it affords demonstrative evidence of the direct derivation of this quadrate form from one which was zonary. If, for example, we select the zonary type, as seen in the cat of the third or fourth week of intra-uterine life, and mark off a quadrate portion of the placental girdle which will be as 9 is to 12, 9 being the width of the girdle and 12 the proportional length of a segment of it measured along its curve, we shall have a placenta which is the morphological equivalent of that seen in the red squirrel.

In the rabbit's uterus of the eighth day of gestation there is a proliferation or thickening of the dorsal or mesometric side of the uterine wall, which betrays distinct traces of a squarish figure. As this represents the site of the future placenta in the rabbit it is plain that the squirrel has retained in a far more

pronounced manner traces of the primitive girdle-like placenta. It seems, in fact, as if that portion of the placental girdle directed away from the blood supply had been suppressed, leaving, as in the case of the red squirrel, only a segment of the original zonary placenta on the mesometric side.

This diversity in the form of the placenta, even in types where the uterus is divided into a pair of tubular cornua, is associated with the mode of vascular supply of the uterine walls. In the cat, mouse and rabbit there is present a rich plexus of vessels all round the uterine tube interposed between the outer and inner muscular coats. The mouse has very few uterine glands, the rabbit and cat on the other hand have them very numerously imbedded in the wall of the mucosa. The area where active proliferation of the uterine wall goes on together with hypertrophy of the uterine gland differs greatly in form in different types. In the mouse the hypertrophy is at first mainly confined to the connective tissues of the uterus; in the rabbit, cat and squirrel it is at first mainly associated with changes in the size, form and thickness of the walls of the tubular glands. All of these phenomena in turn are associated with the manner in which the blood supply for the maternal placenta is distributed. If the blood-vascular supply is developed mainly on the mesometric side, there appears to be a tendency to develop a discoidal placenta from the dorsal segment of the uterine mucosa which is in contact with the embryo and its membranes. If the blood-vascular supply of the uterine walls persists around the whole circumference of the tubular horn of the uterus there will be a tendency to develop a girdle-like placenta, as in the cat. If the muscular supply of the uterus opposite the mesometric side is, on the other hand, suppressed to any great degree, the continuation of the placenta fails to be formed on that side, and the quadrate segment of the girdle leading finally to the discoidal form is developed. As I have shown in a former note, that the mode of contact of the tubular uterine wall with the spherical ovum had something to do with the evolution of a zonary type of placentation, it may be well to indicate in this connection that there is also a physiological factor to be considered in the blood supply of the uterus during gestation and the way in which such supply is modified. The factors at work in the differentiation of the placenta in the mammalia may be said to be mechano-physiological in character. The method of the establishment of formal relations between the surfaces of the embryo and parent during fœtal development are purely mechanical. These

primary conditioning factors are further modified by changes in the physiological processes incident to gestation. While these points just insisted upon must be borne in mind in working out a final interpretation of the method of evolution of the various forms of the placenta, the quadrate placenta of the red squirrel appears to be of great significance, as bridging the gap between the discoidal and zonary forms; it plainly shows how the passage from the one to the other was effected. This is all the more interesting from the circumstance that both square and round forms are met with in one and the same order, but in different suborders.

Recently my views as to the origin of the amnion and placenta have been criticized by Minot in the *Journal of Morphology*, ii., pp. 432-434. In reply, it may be said that my theory of the amnion has little in common with that of Van Beneden and Julin, which is the reason I did not cite them. My theory of the origin of the amnion, despite my critic, remains the only one which is tenable. In the same way, my theory of the genesis of the girdle-like placenta is equally safe from annihilation at the hands of morphologists. As I entertain a great respect for a vast mass of data which might be cited in proof of my position, I should be doing less than my duty not to insist upon standing by the latter.—*J. A. Ryder.*

PHYSIOLOGY.[1]

EFFECTS OF STIMULATING NERVE CELLS.—The fact that activity of a gland cell produces in the cell protoplasm changes, which may be recognized by the microscope, has long been known. Not only is the morphological appearance altered, but also the behavior of the cell toward staining reagents. The highly interesting fact that analogous changes accompany the activity of nerve-cells has been discovered by Donaldson and Hodge[2] in the case of the cells of the posterior root ganglia. Korybutt-Daszkiewicz[3] of the Warschau Pathological Laboratory endeavors to advance the subject one step further by showing that the activity of the cells of

[1] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] Cf. *The American Journal of Psychology*, Vol. i, p. 479, 1888.

[3] *Archiv f. mik. Anatomie*, Vol. xxxiii, p. 51, 1889.

the spinal cord affects the staining qualities of the cells. In the frog the sciatic plexuses are laid bare, the nerves are cut, and the central end of the eighth nerve is stimulated at regular intervals for one hour, each stimulation of three minutes being followed by a rest of two minutes. The spinal cord is then removed, hardened, sectioned, and double-stained with hæmatoxylin and safranin. For a control experiment the spinal cord of another frog is, in each case, prepared in exactly the same manner, with the exception of the nerve stimulation. An active and a resting cord are thus obtained for comparison. The nuclei of the cells of the grey matter are colored—some red and some blue-violet. Enumerations give in the control (resting) cord to 1 red, 8.97 blue nuclei; in the stimulated cord to 1 red, 2.71 blue; in the active cord the relative number of red is 3.31 times greater than in the resting one; in parts of the cord lying immediately adjacent to the entrance of the stimulated nerve, the red nuclei are relatively even more abundant. The chemical condition of the nuclei is evidently altered so as to make them more susceptible to the safranin than to the hæmatoxylin. [It is to be regretted that the author apparently enumerates all the cells, even those of the supporting tissue, with the nerve cells.]

GASEOUS EXCHANGE IN THE LUNGS.—Professor Bohr, of Kopenhagen, has recently carried on a series of experiments, the results of which indicate the incorrectness of the commonly received opinion that the passage of oxygen and carbonic dioxide between the air and the blood in the lungs is a process of simple diffusion.[1] By a modification of Ludwig's stromuhr the blood of the carotid artery of a dog was, in its passage, exposed to the air of a closed chamber until equilibrium had been established between the blood and the air; the latter was then analyzed, and the partial pressures of the gases determined; these partial pressures represent the tensions of the same gases in the blood. The tensions of the gases in the expired air were determined at the same time. In nearly all cases in the blood the carbon dioxide tension was found lower, the oxygen tension higher, than in the expired air. The results would have been still more striking, could the air of the pulmonary alveoli have been used, since there the CO_2 tension is necessarily greater, the O tension less, than in the expired air. The experiments indicate that each gas, in passing through the alveolar and capillary walls passes from a place of low to one of high tension, a fact which

[1] *Centralblatt f. Physiologie*, 1887, p. 293, and 1888, p. 437.

is inexplicable on the hypothesis of diffusion. The author ascribes to the lung tissue a distinct secretory power for both O and CO_2, a quality which is possessed by the swim-bladder of fishes.

DR. H. P. BOWDITCH'S "Hints for Teachers of Physiology"[1] is an admirable little book, intended for the use of teachers in grammar schools and upward. It contains numerous suggestions of methods by which text-book instruction may be supplemented by "simple observations and experiments on living bodies or on organic material, thus imparting to pupils a knowledge of the foundation on which physiology rests, and, at the same time, bringing the impressions made on the senses to aid the memory in retaining the facts communicated in a purely didactic way." Digestion, circulation, motion, voice, animal heat, respiration, vision, and hearing are treated, but by no means exhaustively, for the author does not attempt a complete treatise on physiology. The hints are so excellent that it is a pity that the work is not more full.

PSYCHOLOGY.

MINOT'S REPORT ON DIAGRAM TESTS.—During the past year a large number of postal cards were distributed, each bearing the printed request: "*Please draw ten diagrams on this card, without receiving any suggestion from any other person, and add your name and address.*"

The committee has received for examination 501 postal cards, with diagrams upon them. A few of the cards had more than ten diagrams upon them, and of such cards only the first ten diagrams on each were counted. A few cards had less than ten diagrams.

The cards were divided into three sets; 1, men; 2, women; 3, without names. Each set of cards was numbered, and the diagrams on each card numbered.

Such tests as the diagrams, on which this report is based, demonstrate the slightness of our real individual distinction and separation. The similarity is so great that the same visual images arise in many of us with approximately the same readiness.

We come here to a domain of psychology which has been but little and inadequately studied, namely, the frequency

[1] "Guides for Science Teaching," No. 14, pp. 58, Boston, D. C. Heath & Co., 1889.

and the readiness with which ideas recur. In a previous report in the Proceedings (*ante*, pp. 86) I have shown that even in so indifferent a matter as the ten digits, there are unconscious preferences of the mind, or, in other words, that the notions or images of certain digits come forward oftener and more readily than of others; and I have also shown *ante*, pp. 90-91, that the order of relative frequency is similar for different persons. It is probable that all ideas possess each its special degree of readiness of appearing in consciousness, and that the degree of readiness is approximately the same for a great many persons. This similarity probably also prevails in regard to the majority of ideas.

This aspect of our mental processes puts the problem of thought-transference in a somewhat different light from that in which we have been asked to view it. It is evident that if two people are requested to think of some one thing as a class, such as a letter of the alphabet, a playing card, a baptismal name, there is by no means an equal chance of their selecting any one; on the contrary, there is not only the probability that they will think of a special one first, but there is a chance of their both thinking of the same one, for the relative frequency or preponderance of one idea or image out of a set has been shown to be similar for a number of people. In order to prove the reality of thought-transference, it must be demonstrated that the observed coincidence of thoughts can *not* be explained by the law of relative frequency.—*From Proceedings of the Society of Psychical Research.*

MICROSCOPY.[1]

THE CULTURE OF INFUSORIA.[2]—*Damp chambers.* The first requisite in the culture of infusoria is suitable damp chambers, constructed with a view to reducing the evaporation of the water of the preparations to a minimum. Evidently, bell-jars, admitting a large volume of air, will not serve the purpose. Low, flat-bottomed dishes, with vertical sides, and about 20 cm. in diameter, are recommended. The dish is partly filled with fine, well-washed sand, and in this are planted longitudinally two upright strips of glass, of such a height that the superior edge is 4 or 5 mm. below the level of the edge of the dish.

On these upright pieces as supports are placed three others,

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] E. Maupas. La Multiplication des Infusoires ciliés. *Arch. de Zool. Expér. et Gen.* xvi., no. 2, 1888, p. 179.

the middle one having a width of 4-5 cm., the two others 2 cm. only. It is on these three slips that are placed the object slides bearing the infusoria. The whole is covered by a glass plate, fitted as hermetically as possible to the edge of the dish. The dish being filled with rain water up to the horizontal strips, the air space is reduced to a layer of 4 or 5 mm. in thickness. This layer of air is always saturated with moisture, and the preparations suffer only an extremely feeble evaporation.

For sorting and transporting infusoria, glass pipettes, about 10 cm. long, are used. The tapering end should be thin, and its opening not over 1 mm. in diameter. The infusoria are first placed *en masse* in a large drop of water upon a slide, and examined with a low magnifying power. The inside of the pipette is wet by filling it once with water. An infusorian having been selected under the microscope, the mouth of the pipette is placed near that side of the drop of water where the infusorian is found. As soon as the pipette touches the drop, a portion of it is drawn in by capillary attraction, carrying with it the specimen sought, together with, perhaps, others not wanted. The contents of the pipette are expelled upon a second slide. If the drop contain several infusoria, a drop of rain water is added, and the manœuvre with the pipette repeated. In this way the isolation of an infusorian may be surely and rapidly accomplished. After each operation with the pipette, it should be washed with care, by forcing fresh water through it several times. Some infusoria have a strong adhesive power, and it often happens that they are left adhering to the internal surface of the tube; hence the importance of washing after each experiment.

The isolated individual is covered with an ordinary cover-slip, preferably one 18 mm. square. The cover-slip may be supported by small pieces of bristles from a tooth-brush. As these pieces have a mean thickness of about .3 mm., it follows that the space inclosed represents a volume of about 100 cu. mm., and will hold 10 cg. of water, or about 5 drops. The entire space should be filled with water. It is very important in such work to use pipettes, slides, and slips that are perfectly clean. The least trace of a reagent left on the cover-slip may be enough to render the whole preparation valueless.

Infusoria thus inclosed and protected may live indefinately under perfectly healthful conditions. Supplied with proper food, they will develop and multiply with all the energy of their highest power of reproduction.

Supply of food. In order to supply carnivorous species easily with food, it is necessary to find among the more com-

mon infusoria a species of small size, that can be readily cultivated.

Cryptochilum nigricans answers perfectly these conditions. It is herbivorous, and occurs everywhere in abundance. In order to utilize it as food for carnivorous species, proceed as follows:—Prepare an infusion by cutting up a few pinches of hay in water, and heat the same for a few minutes to a temperature of 60° C. for the purpose of destroying strange species. Allow the infusion to stand two, three, or four days, according to temperature, until Schizomycetes have developed in it; then sow some Cryptochila in it, taking care not to introduce other species at the same time. The vessel containing the infusion should always be covered with a closely-fitted plate of glass. The Cryptochila, finding abundance of food in the Schizomycetes, thrive and multiply by myriads. When the culture begins to decline—as it always will in regular course—it can be revived two or three times by adding crumbs of bread in small quantity. Too much bread causes acid fermentation which destroys the infusoria. Instead of hay, pepper might be employed for these infusions, but it would be necessary to determine by experiment the quantity that could be safely mixed with a given volume of water. Too large quantities have been found to give infusions that checked the development of the infusoria.

Having thus obtained a well stocked infusion, the mode of serving the Cryptochila to the carnivorous species isolated in the manner above described, is as follows:—Place a drop of the infusion on a slide, and cover it with a cover-slip. It will then be seen that the Cryptochila collect round the edge of the cover, and in this position they are easily drawn into a pipette, and then delivered over to the carnivorous species. This mode of feeding enables one to make sure that no foreign species is introduced into the culture. Other species would undoubtedly serve the purpose of food as well as Cryptochilum, for example, *Colpidium colpoda*.

In the culture of herbivorous species, Maupas uses boiled flour as food. A pinch of flour is placed in a sufficiently large quantity of rain water, and boiled two or three minutes. With this pap one can easily supply the needs of Paramaecium, Colpidium, Glaucoma, Vorticella, and probably all species that ordinarily feed almost exclusively on Schizomycetes. This food is easily prepared, and is readily served by allowing it to flow in small quantity under the cover-slip of the preparation. It keeps only a short time, and hence must be renewed every day or two.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

UNITED STATES NATIONAL ACADEMY OF SCIENCES.—The annual stated session of the National Academy of Sciences was held in Washington, D. C., beginning Tuesday, April 16, 1889, at 11 A. M.

The following officers were elected to serve for six years: President, O. C. Marsh; Vice-President, S. P. Langley; Home Secretary, Asaph Hall.

Six members of the council of the academy were also chosen, those elected being Gen. F. A. Walker, Boston Mass., formerly Commissioner of the Census Bureau; Gen. M. C. Meigs and Prof. Simon Newcomb, of Washington; Prof. Ira Remsen, of Johns Hopkins University, Baltimore, Md.; Prof. G. J. Brush, New Haven, Conn., and Dr. B. A. Gould, Cambridge, Mass.

New members of the academy were elected as follows: Prof. Sereno Watson, botanist, Cambridge, Mass.; Prof. Lewis Boss, director Dudley Observatory, Albany, N. Y.; Prof. C. S. Hastings, physics, Sheffield Scientific School, New Haven, Conn.; Prof. Arthur Michael, chemist, College Hill, Mass., Dr. C. A. White, United States Geological Survey.

The following papers were read:

On Composite Coronagraphy,[2] D. P. Todd, introduced by S. Newcomb; Notice on the Method and Results of a Systematic Study of the Action of Definitely Related Chemical Compounds upon Animals,[1] Wolcott Gibbs and Hobart Hare; On Sensations of Color,[1] C. S. Pierce; Determinations of Gravity, C. S. Pierce; On the Pliocene Vertebrate Fauna of Western North America,[1] E. D. Cope; On the North American Proboscidia,[2] E. D. Cope; On the Mass of Saturn,[2] A. Hall, Jr., introduced by G. J. Brush; On the Rate of Reduction of Nitrocompounds,[3] Ira Remsen; On Some Connection Between Taste and Chemical Composition,[3] Ira Remsen; Recent Researches in Atmospheric Electricity,[3] T. C. Mendenhall; Measurement by Light Waves,[3] A. A. Michelson; On the Feasibility of the Establishment of a Light-wave as the Ultimate Standard of Length,[4] A. A. Michelson and E. W. Morley; On the General Laws pertaining to Stellar Variation,[4] S. C. Chandler; Review of the Trivial Names in Piazzi's Star Catalogue,[4] C. H.

[1] Read April 16.
[2] Read April 17.
[3] Read April 18.
[4] Read April 19.

F. Peters; On Cretaceous Flora of North America,[1] J. S. Newberry; Spectrum Photography in the Ultra-Violet,[1] Romyn Hitchcock, introduced by A. Hall; The Plane of Demarcation between the Cambrian and Precambrian Rocks,[1] C. D. Walcott, introduced by R. Pumpelly; Report of the American Eclipse Expedition to Japan, 1887,[1] D. P. Todd, presented by S. Newcomb.

Boston Society of Natural History, Jan. 2, 1889.—Rev. John J. Gulick of Japan read a paper on "Lessons in the Theory of Divergent Evolution, Drawn from the Distribution of the Land Shells of the Sandwich Islands." Dr. Gulick illustrated his talk with specimens of shells from the island of Oahu, and drew several conclusions therefrom. He showed varieties to be but incipient species, and species but special varieties, and stated that divergent evolution does not necessarily depend upon environment. He also stated that areas of distribution vary directly as the power of migration, and in closely allied groups the degree of divergence is measured by the geographical separation. At the close of this paper, Dr. Gulick's ideas were discussed by the members of the society, Professor Hyatt speaking at some length. Dr. D. F. Lincoln then described the "Surface Geology of the Middlesex Fells," illustrating his talk with map drawings and specimens of rocks from the region, after which Mr. J. Walter Fewkes spoke shortly of the significance of the so-called "Fossil Palms" and similar rock formations of the Bermuda Islands. Feb. 21, 1889.—Last November, in connection with work on the Boston, Revere Beach & Lynn railroad, some Indian graves were discovered near Winthrop Centre, and Prof. F. W. Putnam gave the results of his discoveries in the place. He showed lantern views of seven skeletons which were unearthed, together with pictures of weapons, pottery, and shell beads found in the graves. All of the skeletons were found within a small area, and all of them buried in the same positions, their faces toward the east. In all the graves many shells were present.

Mr. H. G. Woodward gave a general description of the geology of Brighton, and the surrounding vicinity, and showed specimens of rocks illustrating the geological peculiarities of the place.

[1] Read April 19.

SCIENTIFIC NEWS.

From 1885 to 1888 the regretted Professor Cienkowsky practised (in Russia) 20,310 vaccinations against *charbon* in sheep. The average loss was 0.87 per 100. In a flock of 11,000 sheep, the ordinary mortality among which was 8.5 to 10.6, the mortality after inoculation fell to 0.13 per 100. In another case, thirteen months after the preventive inoculation, 18 sheep out of 20 resisted the action of virulent charbon.

At the international exhibition of geographical, commercial, and industrial botany, which will be held at Antwerp, in 1890, the third centenary of the invention of the microscope will be celebrated. The exposition will illustrate the past history of the microscope and its present state by means of microscopes and microscopical appurtenances of past and present times, as well as by photo-electrical microscopical exhibitions showing the history and uses of the microscope, animal and vegetable structure, and adulterations of food, etc., etc. These exhibitions will continue during the entire period of the Exposition.

The next meeting of the British Association for the Advancement of the Sciences will be held at Newcastle, (England), from September 11th to 18th.

A Congress of Zoölogists will be held in Paris during the Exposition, in the month of August. Among the patrons as announced, appear the names of men of all nations.

On the shores of Lake Issik-Kul in Central Asia a monument is to be erected to the explorer Prjevalsky, after a design by Bilderling, his comrade. According to the *Invalide Russe* "the monument represents a picturesque rock 28 feet high, on the top of which is perched a large eagle, emblem of strength, intrepidity, and intelligence. The eagle grasps in its talons a map of Central Asia, the arena of the scientific exploits of the deceased, and in its beak an olive branch, symbol of the peaceful scientific conquests which Russia owes to Prjevalsky. On one side of the rock is a large bronze cross, between which is the inscription, 'Nicholas Mikhailovitch Prjevalsky, born 29th of March, 1839, died 20th of October, 1888.' In the interior of the rock is cut a spiral staircase crowned with an enlarged copy of the medal struck by the Academy of Sciences in 1887 in honor of Prjevalsky, and showing the original inscription: 'To the first explorer of Nature in Central Asia.'"

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ARBOREAL TADPOLES.

BY W. J. HOLLAND.[1]

ON the 20th of July, while engaged at Nikko in collecting entomological specimens, I entered a small field enclosed by a low stone wall near the banks of the Daiya-gawa in the lower part of Iri-machi, not far from the famous red bridge. The field had evidently once been used for growing tea, but had lain neglected for several years, and was partly overgrown by weeds and tangled bushes, among which were a good many willows some of them already twenty or more feet in height. While beating this growth for beetles I observed, pendant from the branches of a thrifty clump of willows, several objects which at first reminded me of hornets' nests save that they were of a light reddish color. They hung over a pool of stagnant water about twenty feet in diameter situated upon what I took to have formerly been the site of a house. A nearer inspection of these objects convinced me that they were not infested by aculeate insects and that in attempting to get at them I would not run any painful risk save that of being mired in the stagnant pool. I observed that one of the objects seemed to be in an apparently decomposing condition, saturated with moisture, and dropping to pieces. Long filaments of slimy froth-like matter were hanging from it, and clinging in streamers from the twigs of the trees just below. I also ob-

[1]Naturalist of the U. S. Eclipse Expedition to Japan, 1887. Extract from the Report of the Expedition made by Prof. D. P. Todd and presented by Prof. Simon Newcomb, at the meeting of the National Academy of Sciences, April 19, 1889.

served a great many black ants traveling out upon the willow twigs, and a few of them apparently entangled upon the surface of the mass which was falling to pieces. With some difficulty and with the help of a coolie, I succeeded in drawing the most perfect of these objects within reach, and by cutting the willow branches getting it entire to the ground.

I was quite confident that it was of insect origin and my curiosity to ascertain its nature and structure was great. I asked the coolie what it was. His reply was the usual "Wakarimasen," *Anglice* "don't know." The outer surface was dry and had the appearance of very thin brown wafer. At the places where the willow twigs passed in and out of the mass there were projecting points and at the apices of these in several instances there was an exudation of glairy matter, which had the appearance of very fine soap suds. All over the exterior were the bodies and wings of small insects which had evidently been entrapped in the mass when it had been soft. A few ants and flies were struggling in the bubbly, vesicular scum, which was freshest near one or two of the branches at their insertion into the mass, as I have described. Taking my pocket knife I opened the curious structure and found its interior to be composed of a mass of tough, glairy, froth, resembling the white of an egg that has been well beaten, but of a dirty, yellowish brown color. What, however, was my amazement to find scattered through it, and wriggling about hither and thither, a colony of tadpoles, of which I counted twenty-two. They were black in color with white bellies, exceedingly lively, and apparently, very much at home. Here and there in the mass were the remains of insects, principally legs and wings and the chitinous outer coverings of the abdominal and thoracic segments of black ants.

Having no means of preserving the tadpoles with me, as I had hastily gone to Nikko with Professor Todd, leaving my alcohol behind me at Tokio, I resolved to let the best of the remaining two nests remain until the morning of the 22d, when I resolved to secure it, and if possible take it with me to Tokio. I however took down the largest of the two remain-

ing nests, which was already beginning to drop to pieces. In this were also a few tadpoles. A diligent search of the pool failed to reveal any tadpoles in its shallow, miry depths. The next day I revisited the spot. The nest I had designated for myself still remained undisturbed upon the branches, but was drenched with the passing showers. It rains at Nikko in July every day beginning about noon. I made a rough sketch of the object. The following day I repaired to the spot to get the nest, and also armed with a large jar kindly provided by Dr. Whitney, into which to put the tadpoles, and scum should it come to pieces. Unfortunately during the night the elements had made partial wreck of the coveted prize. It was broken in places and hanging down in wet streamers. I took a number of these with the enclosed tadpoles and put them into the jar. But soon they dried up. All that I had left to me was a mass of partly desiccated scum, with some dead tadpoles in it. I allowing this to dry out hard and in this state brought it home to America.

Upon examination I find that the tadpoles have been preserved in the mass in a highly desiccated condition. When alive they were about three quarters of an inch in length. In their dried form they are, it is needless to say, much smaller. By immersing in a mixture of glycerine and water, I have succeeded in partially restoring the form to one or two of them.

These with the bulk of the dried froth I have sent to Prof. Edw. D. Cope, of Philadelphia, who assures me that the phenomenon I have observed is one of much novelty.[1]

Chiromantis guineënsis is said to deposit its eggs upon the branches of trees on the margin of streams in Western Tropical Africa, surrounding them by a frothy, viscous mass of

[1]Since writing the above I have received a letter from Professor Cope, from which I make the following extract:

"The larvæ are different from those of terrestrial Batrachia in possessing a large hypoblastic yolk, the only approach to such condition having been describen in the Genus Alytes. Large yolks are reported in certain tree-frogs, and a few others, and it becomes interesting to know the type of frog which has laid these arboreal eggs. Professor J. A. Ryder to whom I submitted the dried eggs, says that the intercellular corpuscles have the truncate form usual in Batrachia."

matter, which is dissolved by the moisture in the rainy season when they become detached and drop into the water where they are hatched. A similar phenomenon has been observed in the case of one of the Hylidæ which has its habitat in Southern Brazil; but in neither case has it been observed that the eggs hatch while attached to the trees. In the case of the Japanese Batrachian it is plain that the hatching takes place upon the trees and the larva possibly undergoes some of its transformations in the nidus suspended among the branches. Whether the glairy mass is due to the swelling, under the action of the semi-tropical rains, of material deposited by the female at the time of oviposition I cannot tell. As against this view is the fact that the dried scum after prolonged soaking in water fails to regain its old vesicular, bubbly form. It may be that the froth is secreted by the bodies of the tadpoles themselves, or that both the tadpoles and the parent batrachian are concerned in its production The large quantity of the mass favors the latter view. The nests were fully a foot in diameter. The presence of dead insects in large numbers in the midst of the masses as well as adhering to its outside suggests that the tadpoles feed upon these.

I looked diligently for the adult batrachian in the vicinity, but failed to discover any frogs in the trees near by or in the pool. Later in the season the trees and bushes are fully alive in places with Hylidæ.

I trust some observer with better opportunities than I had in my brief and hurried visit to Nikko will solve the mysteries of the life history of these arboreal tadpoles.

EXPLANATION OF PLATE XVII.

Fig. 1. Section of nest one-third natural size, representing internal structure and position of tadpoles in the mass.

Fig. 2. Sketch presenting a view of the position of the tadpoles amidst the vesicles. (Enlarged.)

ACROSS THE SANTA BARBARA CHANNEL.

BY J. WALTER FEWKES.

(Concluded from the April Number.)

ON our return to the "Angel Dolly" we found that our cook had prepared a most delicious dinner on shore. We had roast leg of mutton, cooked on a spit, abalones fried and stewed, and coffee. The abalones we collected everywhere on the shore. The animal was cut out of its shell, pounded until tender in an Indian mortar, and then fried in batter. The taste of these animals, after our row in the open air, was fine, but it is doubtful whether we would have eaten the abalones with the same zest under any other circumstances. We ate our dinner under an overhanging roof of rock in a partially formed cave, the floor of which was the shingle of the beach of the cañon. I was reminded of the times when wild men did the same, probably in the same cave, as the abundant shell heaps and inscriptions show that they undoubtedly did. On the roof of the cave there was noticed a curious product of the erosion of the rock, such as I have never seen before. In the mass of conglomerate there is a pocket of grayish rock projecting from the surface and worn into cells, the edges of which stand out in sharp relief. These cells, not unlike honeycomb in form, are rounded, smooth, and several inches in diameter. The edges of the cells are sharp and smooth. The mode of formation of this curious pocket is not clear to me. It is a mass of rock several feet in width, and was formed on the roof of the overhanging conglomerate under which we ate our dinner.

In the afternoon we tried collecting on the black reef, which partially breaks the sea from Star Cañon on the east. I found the sea very high on the reef, but on the lee side a few good things were found. We noticed that the rocks on the seaward side were covered with mussels, among which were a few sea-urchins and beautiful starfishes. The bottoms of the pools in the reef were covered with Zoophytes which, when fully expanded, made them look like flower beds. Among them

were several large Anemones of the genus Bunodes, and many Serpula. Many of the Actinians were over a foot in diameter when fully expanded. The rock which composes the reef is a black asphaltic formation, similar to the embedded rock of the conglomerate on the shore.

We returned to the "Angel Dolly," and found the cook had caught two large fishes known as Garibaldis, which with "craw-fish," Panulirus, were served for our supper on board the schooner.

The mainland of Santa Barbara looked dim in the distance as I walked the deck after supper, but the sky above us was clear, and I watched the evening star, Venus, sink below the top of Monte Diablo. It was a very beautiful sight. The air was calm, and there was but a slight swell on the surface of the Channel, which had an almost glassy calm. I was, however, tired out by my experiences, had a good night's rest preparatory to new exploration on the morrow.

On the next morning we concluded to take the "Angel Dolly" up to Prisoner's Harbor, several miles to the eastward of Star Cañon. I thought the best way for me to study the cliffs was to follow in a boat, letting the schooner work up under sail. This seemed more expedient, since the Harbor was exactly to the windward, and there seemed indications that the winds would be light. and perhaps it would be impossible to sail near the coast. The wind, however, freshened considerably after we started, and the "Angel Dolly" worked far ahead, standing out into the Channel. There was a heavy swell throwing high breakers on the cliffs.

Wherever we landed in our trip we were obliged to beach the boat through the breakers, and we were often plunged to our waists in water in landing. Just to the east of Star Cañon, after rounding the black ledge which was my collecting ground the day before, we coasted along past the "Indian Cemetery," from which many Indian remains have already been gathered, and in which many more are still buried. There seemed to be two separate regions of shell heaps, although the whole coast in this vicinity is white with the

shells and debris of the camps of bygone times. In these burial grounds the individual graves were formerly indicated by the ribs or lower jawbones of whales set in the earth above them. None of these now exist, and these shell-heaps have long ago been dug into by eastern collectors. The shell-heaps were not wooded, but here and there are large patches of the prickly pear or "Tunis," and flocks of sheep now graze over the graves of the former lords of the island.

We continued our row past the Indian Cemetery to a natural archway, eroded by the sea, formed by a projecting cliff, on each side of which there is a deep cañon with precipitant cliffs on either side. The cliffs of these cañons are possibly 200 feet high, and so abrupt that they seem almost perpendicular. These natural archways rival in size the famous *Arco Naturale* of Capri, and are among the most instructive instances of erosion on the Californian coast. Of two fiords separated by the cliff of conglomerate, one which we may call Southeast Cañon has a long, narrow entrance, and is stopped up at its entrance by large boulders, which prevent access to the cañon. There is, however, a small, gravelly beach at the mouth of this cañon, upon which we landed. On the right, as we entered, there is a picturesque natural archway, with an old Indian fireplace perched upon it. There are a few pines and wild flowers growing from the crevices in the cliff. A buttress which divides the two fiords from each other is composed of conglomerate. On the right and left are slates in stratified masses, and red colored rocks, the conglomerate above the slates.

From these two cañons we made our way to Prisoner's Harbor, and after some difficulty boarded the "Angel Dolly," which came up soon after.

Without anchoring, for a considerable sea had arisen, we continued to the eastward of Prisoner's Harbor to a point opsite Chinese Harbor, and cast our anchor in smooth water near shore. The rocks at this place differ greatly fom those at Star Cañon. Here we find variegated formations forming white, chalk-like cliff much eroded, and very different from the black, asphaltic rocks of the region to the west of Prisoner's Harbor.

The hills about Chinese Harbor are white and red, and show marked terraces of elevation. At their base there is a continuous beach, made up of small stones and shingle. On the side of the cliff are many bushes, but no trees. The collecting on the beach gave me many mussels, abalones, and a few starfishes. The sea near the beach is turbid with sand, reminding me of the white water of the Florida Reefs.

The hills about Prisoner's Harbor were clothed with verdure. There is a good wharf, and near it the warehouse and a cluster of buildings belonging to the company which owns the island. The hills near the landing place are not as high as those at Star Cañon, and resemble those to the eastward. It is this formation which is mentioned in the meagre accounts which we have of the geology of the island of Santa Cruz.

At Prisoner's Harbor I collected many interesting animals, among which might be mentioned a huge Nudibranch, Chioræa, allied to Aplysia, many starfishes, sea-urchins, and molluscs. Here also I found the interesting Helix,[1] said to be peculiar to the island. One of the most interesting genera of Annelids collected on the rocks near the half-tide mark is the well known Sabellaria. Sabellaria on the Pacific coast builds a thick mass of sandy tubes cemented together, forming on the rocks an incrustation of great thickness. At Punta del Castillo near the end of the beach at Santa Barbara great masses of these colonial worm tubes can be seen, forming a honeycomb structure on the rocks left by every retreating tide. Each worm tube when left out of water is closed by a circular operculum which effectually blocks up the entrance, forming a kind of door to prevent possibly the egress of water. By this simple arrangement the animal can live for a long time out of the water. A most interesting method of casting off the excrementa is also illustrated in this worm. The operculum is situated at the cephalic extremity of the animal, and as the masses of tubes are crowded together, the posterior extremity of the animal is

[1] This species is rapidly being exterminated by the sheep, and in no short time will probably be extinct except in inaccessible cañons. Mr. Gulick records a like fate for certain Achatinellas peculiar to the Sandwich Islands.

brought to the blind ends of the tubes. There is, however, appended to this extremity a long tube, which, bending backward, opens near the open end of the case of sand. The vent of the animal is situated at the extremity of this tube and is thus brought to the surrounding water.

Encrusting the rocks in several places we also found a moist deposit of sand of one or two inches in thickness, also closely connected with an interesting habit of another and different group of marine animals. Bunodes, a common Actinian of the southern Californian coast covers itself with a coating of sand, and when the tide falls the animal contracts its tentacles, and nothing is to be seen but this sandy deposit, concealing the body of the Actinian. In this way the genus lives between successive rise and fall of the sea, shielded under its coating of sand for hours, enduring great changes of temperature and the lack of the pure sea water. Colonies of these Bunodes were found many feet above the low-water mark. They also are common on the rocks of the well known headland, Punta del Castillo, and can without difficulty be observed by anyone who will visit this locality at low or half tide.

The island of Santa Cruz, as pointed out by Mr. Greene, has a peculiar flora which has many species not found on the neighboring continent, and genera which are only found in lands widely distant from it. It has also a peculiar species cf Helix. In a word, although a continental island in its fauna and flora it reminds one of an oceanic island. Shall we interpret these facts by regarding it as a remnant of a continent or large body of land contiguous to California now submerged, or are other explanations to be sought? There is certainly not much to indicate an oceanic character to the Santa Barbara islands. Their peculiarity of flora can readily be explained by considering a change which has taken place in the climate of the mainland without affecting that of the islands. A change in the amount of moisture may have driven out the less hardy genera from the mainland, but left them still to survive on the islands. Moreover, a glacial period in California may have driven more hardy plants southward into a struggle with the less strong, in which

the latter have succumbed. In a desiccation of the country the progress of the change would be less rapid on the island.

It seems to me that there is evidence that the island of Santa Cruz has lately been elevated out of the sea. This is the story of Ragged Mountain with its cleft summit, and of the elevated terraces to the west of Chinese Harbor. The deep cañons, however, show a much larger rainfall in the past when they were made than at present, and the enclosed asphaltic boulders standing out in the conglomerate are good indications of great erosion. The huge rocks blocking up the entrance to the cañons do not seem to have been brought there from the hilltops, but eroded by a mountain torrent on either side have simply dropped into the position which they now occupy. In most of these cañons the torrents which caused them have dwindled in size, although still large in the rainy season, while in many their beds are now dry during part of the year. If there ever was a glacial period on this island the tracks of it at present have been obliterated, or were not discovered in my superficial examination. There has been great erosion, but the boulders clinging to the worn side of the rock by one angle would seem to indicate that that erosion was by water rather than ice.

As we left Santa Cruz on our return trip we sailed through multitudes of a beautiful Velella, common in the channel at certain seasons of the year. These little blue sail-boats are often thrown up on the beach at Santa Barbara, and are common as far north as Monterey and San Francisco. Its northern limit is many miles north even of the limits of the state.

A curious little physophore, *Athorybia californica*[1] was also seen in the channel near Santa Cruz. This beautiful animal has never before been recorded from the Pacific waters of our west coast, although a similar genus has been described by the author from Key West and the Florida Keys.

The largest and most attractive of the Medusæ seen in my trip back was a mammoth Pelagia with mouth tentacles four feet long, and of a beautiful pink color. A lovely Hydromedusa,

1 An account of the anatomy of this physophore is given in the *Annals and Magazine of Natural History*.

polyorchis, is one of the most common jellyfishes in these waters.

Perhaps the most interesting of all the Medusan denizens of the fiords of Santa Cruz is a small Hydromedusa, not larger than a small pea, which has this remarkable character. In place of clusters of tentacles about the margin of the bell it has but a single tentacle placed at the point of junction of the radial tube and the circular vessel. This single tentacle is a short, stiff appendage, exactly similar to one of the four tentacles of Dipurena, a genus found at Newport, Rhode Island. It is, in fact, as if we had a Dipurena with three of the tentacles missing and a single one remaining. In this Californian genus, however, there is but one of these curious, club-shaped, stiff appendages. A similar genus has never been recorded; to this species I have given the name *Microcampana conica.* The most peculiar structural character is found in the number of radial vessels in this jellyfish. All similar Hydromedusæ have but four, eight, or more radial tubes. There are some which have six, which however are not related to Microcampana. This genus has six radial tubes. Moreover, there exists on the apex of the bell, as in our Stomatoca, a prominent prolongation or projection never seen in Dipurena, its nearest ally.

There are many other Hydromedusæ in these waters, a notice of which would prolong this account beyond its limits. A huge Sphaeronectes, with a bell a quarter of an inch in diameter, a genus never seen before on this or on the Atlantic coast of the United States, a beautiful Physophore, Diphyes, and a host of others[1] were found.

On the return trip to Santa Barbara we sailed through a most extraordinary region of the channel in which there is a submarine petroleum well. The surface for a considerable distance is covered with oil, which oozes up from sources below the water, and its odor is very marked. The oil probably comes from the upturned asphaltic strata deep below the sea.

Near the oil well we sent down our dredge and brought up a most interesting Polyzoan, an account of which I have al-

[1] A full description of these animals with figures will soon be published by me.

ready published in the January number of the *Annals and Magazine of Natural History.* This animal has a jointed stem and an oval zoœcium. When it first came on board I thought I had discovered a living Cystoid or Blastoid, as its shape was almost the same as that of some genera belonging to these types so familiar to the geologist, but now long extinct. In this, however, I was disappointed, although abundantly rewarded in finding a new genus of Polyozoa, Astrorhiza.

The dredge also brought up great masses of a Retepora, which is called coral by the sailors in this locality, and are sometimes larger than a man's head. Innumerable other lower animals people these depths.

A fair but light wind brought us back to the wharf of Santa Barbara early in the evening of the day we left Prisoner's Harbor. We heard the sound of the evening bells of the Mission Church come down the side of the mesa, and as we threw our anchor the bright electric light of the city welcomed us home. The next morning a haze covered the base of the island of the Holy Cross, out of which rose the peak of Ragged Mountain like a monster from the sea. As the day wore on the fog lifted, and the soft African haze which gives the great charm to Santa Barbara ocean scenery took its place and the form of the beautiful island came out in all its extent, its outlines softened by the distance, and its dark cañons alternating with projecting headlands indistinguishable over the stretch of water which separates it from the mainland. The same island stands out clear in the beautiful light, unchanged since Cabrillo sailed up the channel for the first time fifty years after Columbus discovered the New World.

THE VEGETATION OF HOT SPRINGS.

BY WALTER HARVEY WEED.

THE vegetation of hot waters, though lowly organized and composed of obscure forms, is of considerable interest to all students of Nature, since the plants occur in very highly heated and mineralized waters under conditions that are fatal

to all other forms of life. The ability possessed by the vegetation found in such waters to withstand such extreme and adverse conditions of environment shows the possible existence of this form of life during the early history of our globe, when the crust of the earth is supposed to have been covered with hot and highly mineralized waters. Such plants may thus represent the earliest links in the chain of evolution.

While the mosses Hypnum and Sphagnum have been found in warm waters (90°–100° Fahr.), the vegetable life of hot water consists wholly of fresh water algæ. Such plants are usually less striking in appearance than the sea-weeds, but assume most curious and interesting forms when subjected to the peculiar conditions that prevail in hot springs.

It has long been known that algæ occur in hot waters, and the descriptions of hot springs given by travelers often contain allusions to the presence of bright green "confervæ" living in the hot pools and streams. Algæ are common also in the hot waste waters flowing from many mills, the brilliant green growths lining the conduits. Where the plants present in thermal waters are of this color, their vegetable nature seems to have been readily recognized; but there is good reason to believe that the existence of algæ of other colors, particularly the pink, yellow and red, forms so common in the Yellowstone waters, have been overlooked or mistaken for deposits of purely mineral matter. That such is the case is not at all surprising, for the plants often surround themselves with a hyaline gelatinous envelope, or are encrusted and hidden by mineral matter extracted from, or deposited by, the hot waters, and sometimes obscuring the plant growth so completely that the organic nature of the substance is scarcely recognizable even by an algologist. Thus the Beggiatoæ, the characteristic vegetation of sulphur springs, were long considered a lifeless organic slime. Their silky threads are often completely hidden by grains of sulphur, or entombed beneath a deposit of gypsum.

The vegetable life of hot calcareous waters is very often

shrouded in carbonate of lime, the growing tips alone projecting out of the stony mass. In ferruginous and in siliceous waters the mineral matter of the waters obscures and hides the vegetable filaments. Unfortunately, those who have studied the flora of hot springs have rarely published sufficient detail concerning the habitat of the species described to enable one to follow up this interesting feature of the subject, while the algæ have been studied rather from a systematic than a broad biological standpoint.

In reviewing the literature bearing upon the subject, I have found that vegetable life is a common accompaniment of thermal springs, and as widely distributed as the springs themselves. At the noted warm springs of Carlsbad, where the algous life has been studied by several botanists, there is a great variety of species, but the limiting temperature appears to be 130° Fahr.[1]

Sir William Hooker[2] and Baring Gould[3] both mention the occurrence of crimson algæ in the hot geyser waters of Iceland, and Hochstetter[4] and other writers[5] describe slimy confervoid plants lining the bottoms of hot pools and streams in New Zealand, the highest temperature at which such growths have been observed being 153° Fahr.

In the hot springs of the Azores, Mosely found algæ growing in water whose temperature was between 149° Fahr. and 156° Fahr., and on areas splashed by almost boiling water. At the volcano of Camiguin no vegetation was found until the water had cooled down to 113.5° Fahr.[6] In the Himalayan hot springs Dr. Hooker found a luxuriant growth of Leptothrix at 168°Fahr. and below.[7] Several other references were

[1] Abhandl. Schles. Gesell. 1862. Heft II.

[2] Journal of a Tour in Iceland. Vol. I., p. 160.

[3] Iceland: Its Scenes and Sagas.

[4] Reise der Oe Frigate Novara.

[5] Skey. Trans. N. Z. Inst. Vol. X., p. 433. Spencer. Trans. N. Z. Inst. Vol. XV., p. 302.

[6] Journ. Linn. Soc. (Botany.) Vol. XIV., p. 328.

[7] Himalayan Travels. Jos. Dalton Hooker. Vol. I., pp. 27, 379.

found proving the abundance of algæ in waters of 150° Fahr. or below. The highest temperature at which these growths have been found is that observed by Professor Brewer at Pluton Creek, California, where algæ were found at 200° Fahr.[1]

In the hot springs of Ischia no life was observed above 185° Fahr.,[2] and this appears to be the limiting temperature in the hot waters of the Yellowstone National Park.

A comparison of the species found in hot springs shows that they are limited to a few groups. Although the true Confervoideæ and the Protococcoideæ are represented in gatherings from hot waters, the Oscillatorieæ form the most characteristic vegetation of hot springs, species of Oscillaria and Hypheothrix being very common. *Hypheothrix laminosa* (a species variously known under a number of synonyms) has been found in New Zealand, Java, St. Paul, Camiguin, Iceland (?) and the Yellowstone Park, being very common at the last locality.

Desmids have been found in the hot waters of the Azores, three species of Pediastrum being described, and Corda figures and describes Desmids from the Carlsbad hot springs. The Diatomaceæ do not appear to be very abundant in hot waters. Dr. Jas. Blake found a number of species at 140° Fahr. in the hot springs of Nevada, and nine species were found by Berkeley in the gatherings from Thibet. They are comparatively rare in the Yellowstone gatherings from hot water, but very abundant in the cooled waters from the springs.

The examinations made by Mr. W. Archer of the gatherings of algæ from the hot springs of the Azores show that certain species were identical with forms common in cold surface waters in Great Britain. Prof. W. G. Farlow, of Harvard, who is studying a series of specimens collected by the writer from the hot waters of the Yellowstone Park, informs me that here also cold water forms are found, but modified by their conditions of environment. It is hoped the material in Professor

[1] Amer. Journ. Sci. (2.) XLVI., p. 31.

[2] Sachs, in *Flora*. 1864.

Farlow's hands will yield important information concerning the morphology of the species.

In a study of the hot springs and the geyser phenomena of the Yellowstone National Park, carried on in connection with my geological work in that region, I was surprised to find an abundant algous vegetation in the hot springs even at very high temperatures. It has been found by an examination of the hot springs of the region, of which nearly 3,500 have been individually and carefully noted, that algæ are almost universally present either in the springs themselves or in the streams flowing from them. The only exceptions to this are the mud bowls, and even here algæ are often found on the borders where kept moist by steam. This widespread occurrence implies that algæ can exist under a very great diversity of conditions. The springs examined differ greatly in the chemical composition of their waters, and include carbonated, calcareous and siliceous alkaline waters, and also those acid with hydrochloric or with sulphuric acids. The algæ also occur under equally diverse thermometric and hygrometric conditions; they have been found at all temperatures up to 185° Fahr., though from 160° to 185° they have thus far been observed only in running streams.

It is difficult to give a general description of the vegetable life of hot springs which shall be brief, and yet convey any idea of the beauty and the varied forms of these growths. The vegetation of the acid waters (with free HCl or H_2SO_4) is seldom a conspicuous feature of the springs. But in the alkaline waters that characterize the geyser basins, and in the carbonated, calcareous waters of the mammoth hot springs, the case is otherwise, and the red and yellow tints of the algæ combine with the weird whiteness of the sinter and the varied blue and green of the hot water to form a scene that is, without doubt, one of the most beautiful as well as one of the strangest sights in the world. Those who have been so fortunate as to have seen the hot water fountains of the Yellowstone will be sure to remember the delicate and charming tints that characterize the basins about Old Faithful and many other geysers

of the upper basin, as well as the bright reds and yellows of Specimen Lake and the Orange Pool.

Early in the study which was made of these springs, it was noticed that the color of the vegetation was, in a degree, dependent upon, or related to, the temperature of the water. This is well illustrated by the occurrence of *Hypheothrix laminosa*, whose delicate filaments wave in the stream draining the Black Sand, where the following relation of color to temperature was observed:

White—185°.

Flesh pink—181°, becoming browner as the temperature falls.

Pale yellow—164°.

Yellow green—155°.

Emerald green—135°–140°.

Dark green—130°. These colors merging, of course, into one another, but being very prominent at the temperature given. Other growths are:

Orange—125°.

Red—110°.

Cedar brown—90°.

An examination of the growths forming the first series by Professor Farlow proves that the flesh-colored and white growth, occurring at 180°–185°, shows but traces of algæ filaments in amorphous matter. At 164° the structure was more decidedly filamentary and the color light yellow. The bright green forms at 155° were in a better condition for study, and the dark green filaments at 130° were in good condition. *Hypheothrix laminosa* probably attains its fullest and most perfect development in these waters between 130° and 155° Fahr.

In those clear bowls of hot but never boiling water called *laugs*, the algæ often form a leathery sheet lining the sides and bottom of the pools. Each sheet consists of a great number of thin, membranous layers aggregating one-fourth to one-half inch in thickness; the under layers are a rich tomato red, and the surface covered with a thin, incoherent

fuzz of green, through which the red tint beneath shows and produces an olive tone.

The algæ tinting the hotter *laugs*, with temperatures of 140° to 160° Fahr., are bright yellow, and form a loose, velvety nap on the soft, siliceous sediment.

Where the overflow from a spring is constant in volume the channels are rapidly filled, choked and dammed back by masses of red and green algous jelly from one-half to five inches thick. This form of growth and the process of sinter formation has been already described elsewhere.[1] The channels carrying off the periodic discharge of the geysers are also brilliantly tinted by algæ, but modified by the deposit of silica. The channels of Old Faithful are a brilliant gamboge yellow near the geyser, merging into orange, which changes abruptly into brown, while farther away the growth is cedar red.

In these cases the plants form a thin, slippery coating upon the siliceous sinter, and is much encrusted by silica. Where from any cause the algæ growing in these channels are deprived of their supply of water, the siliceous jelly enveloping the growth is rapidly dried, and becomes hard, white and opaque, effectually concealing the algæ. Where channels are lined with a membranous growth, this shrivels up into curious convoluted forms, or into papyrus-like rolls. In fact, whatever the nature of the algæ present in the siliceous waters, all appearance of vegetable life is soon lost on drying, owing to the hardening of the silica. In calcareous waters the change is none the less complete, and the green or red growth rapidly bleaches out and becomes all but invisible to the casual observer in the deposit. The filaments may, however, be freed from the lime by the aid of acid.

[1] Amer. Journ. Sci. May, 1889.

PLATE XVIII.

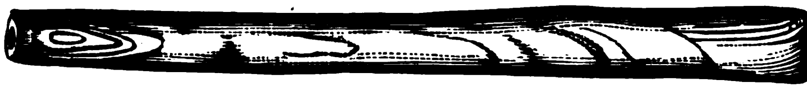

Fig. 1. Shell Bead.

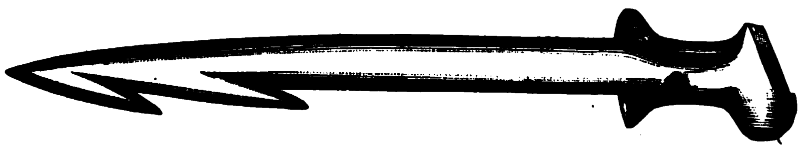

Fig. 2. Bone Harpoon.

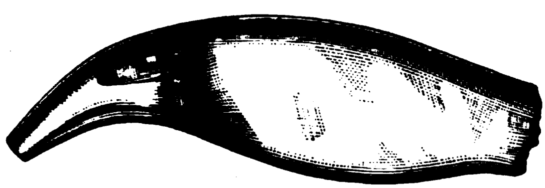

Fig. 3. Bear's Tooth.

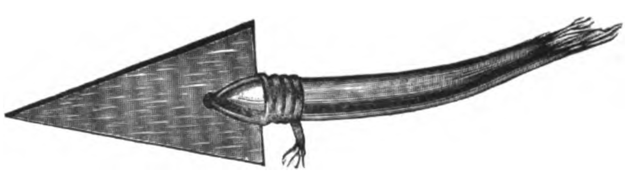

Fig. 4. Arrow-head.

CAYUGA INDIAN RELICS.

CAYUGA INDIAN RELICS.

BY W. M. BEAUCHAMP.[1]

I HAVE been much indebted to Mr. W. W. Adams, of Mapleton, Cayuga County, for valuable information regarding New York Iroquois sites, and for the opportunity of examining and figuring many fine and remarkable relics. Like some other parts of the Iroquois territory, the occupation of the country about Cayuga Lake, by settled inhabitants, seems very recent. There are a few old sites, but by far the larger part are of historic times. There are half a dozen early earthworks in the county, but most of them are distant from the lake. As in the country of the early Senecas, there is little earthenware, and that of a coarse kind, contrasting strongly with the abundant supply of the territory of the Onondagas and Mohawks. From history, traditions and remains, as well as language, it seems probable that the Cayugas and Senecas branched off from the parent stock at Lake Erie, perhaps on both sides; while the three eastern nations led the van on the north of Lake Ontario to the St. Lawrence, and thence passed southward to their later homes. Archæologists certainly have good reasons for such a belief.

There were travelers and early hunters and fishermen along Cayuga Lake, some of whom had small villages there for a time. A few left mica in graves, and lost some fine articles in the camps or by the wayside. Long shell beads were used by some, and as these have been found in recent graves as well, they form a link with the past. The wearers were probably the first true Cayugas. These long beads were formed from the columellæ of sea shells, and one is six and three-quarter inches long, while a number are but little less. Out of one

[1] Rev. W. M. Beauchamp has long been noted for his investigation of Indian archæology in Western New York. He is an indefatigable laborer, and his investigations have been of great benefit to the science. He is more disposed to observe and record facts than to develop theories. His last remark in the above paper is worthy of consideration. It has come to be a maxim in some parts of the world that prehistoric objects are to be found, not in number as they exist, but according to the number and diligence of their seekers.—T. W.

grave Mr. Adams took four which aggregated twenty-two inches, and six more formed a line of the same length. Fig. 1 is of the exact size of one of six taken from a grave last year. This grave contained a most curious assortment of articles, of which I will speak particularly before concluding. While smaller beads of this kind occur on historic sites, and very rarely on prehistoric villages, I know of none so large elsewhere in New York. The chiefs who wore them in their first splendor must have been proud of their ornaments.

While prehistoric shell beads of any kind are so rare through the old Iroquois territory of New York, the small council wampum, of course, is found only on later sites. The Five Nations had none of this before the coming of the Dutch. This is a fact now clearly established. There are other late beads of bone, stone, porcelain, glass, and discoid and oval shell beads. Sometimes mere shells of Melampus and Marginella have been strung, but never any fresh water univalves, as far as I know. The Venetian glass beads are often of many colors and intricate patterns, and sometimes of singular beauty. Some plainer glass beads are quite attractive also.

Ornaments of perforated red slate and pipestone belong also to the later sites, but most of those gathered by Mr. Adams now grace the cabinet of Mr. A. G. Richmond, of Canajoharie. A pretty little mask of Catlinite, smaller than a finger nail, came from a recent Cayuga grave. I have seen but one other as small, and that from an Onondaga site of A. D. 1700. Shell and bone ornaments include the familiar Iroquois forms of disks, crescents, fishes, and those to which we can hardly give a name. Combs came with the white man, but the Indian soon made for himself those of bone or horn, the top generally symmetrically arranged, as two men, two serpents, two birds. Fine examples of these have come from Cayuga sites—indeed, the best I have seen.

The bone harpoon, Fig. 2, is from a recent Cayuga grave, and most large harpoons that I have known are not old, say two hundred and fifty years or less. I have figured them from historic sites of the Onondagas and Mohawks besides.

This one is stained red, a rare feature, and it presents other peculiarities. A smaller slender and delicate harpoon was found near the lake shore, and I have seen none prettier. It has six barbs on either side, and seems much older than the one represented. The same form, but less delicate, occurs on the Seneca River.

Both copper and iron fish-hooks are met with, and sometimes the corroded metal has preserved the cord. None of bone or horn have appeared near Cayuga Lake, though several have been found in Onondaga and Jefferson Counties. Three or four prehistoric specimens, with barbs, have come to my notice. Among other Cayuga fishing implements are innumerable flat sinkers and perhaps the ovoid grooved stones. The former are of more general distribution than the latter.

Bears' teeth occur, as in other places. Fig. 3 is one of sixteen from the same grave. They were used much earlier, and often perforated for suspension. Human teeth I have found thus perforated. While examining an old Cayuga burial place, Mr. S. L. Frey, of Palatine Bridge, found an arrow made of a fossil shark's tooth, only altered by cutting slits to bind it to the shaft. A single glass bead, found at the same time, makes its age doubtful.

Stone arrow and spear-heads are in moderate numbers; scrapers and drills very rare, owing to the small number of early Cayuga sites, these being early implements. Some of the triangular arrows, made of sheet copper or brass, occur, generally with one or two perforations for binding the arrow, but sometimes with none. Fig. 4 shows one with part of the shaft remaining attached. They are of the same pattern as those found with the Fall River skeleton. Mr. Adams has also belts with copper tubes, suggesting those encircling the skeleton mentioned. Such arrows in Onondaga belong to the latter half of the seventeenth century. The copper age of the Five Nations lasted nearly a century, when they adopted silver for ornaments. During the earlier period of European contact they used copper wire bracelets, brooches and ear-rings, bronze rings, copper beads, and other articles. Of these Cayuga

affords good examples, as well as the other cantons. Iron is found on all recent sites.

Good clay pipes have proved abundant near Cayuga Lake, and the ridge along the sides of the stems of many is an unusual feature. They present the common variety in form and ornament. Fig. 5 is called a wolf-totem pipe by Mr. Adams, who took it from a grave last spring. It is of the type common two hundred years ago. A little later the Indians reversed the arrangement of the head or ornament. A curious detached terra cotta Cayuga ornament represents a man's head with a pointed helmet. These detached ornaments are found in other parts of the Iroquois territory. Slender pewter and iron pipes are rarer, but the former have quite a range. Stone pipes were little used by the Cayugas or their predecessors.

Figs. 6 and 7 Mr. Adams calls gambling flints. The larger one may be a frequent form of knife, or he may be correct in his name. The smaller one is quite likely to have had such a use. Had they shown signs of wear, I might have thought them Indian gun-flints; but there is no good reason for this, and their place in a chief's grave gives them some importance. They are not of the scraper form, and are too small for ordinary knives. Twenty-one occurred in one Cayuga grave, but I have found them singly in Onondaga County. They are neatly chipped, and suggest the bone, stone and clay counters once used, now represented by peach stones and deer buttons.

One curious article Mr. Adams has loaned me, which is probably old. The point of a flint arrow had been broken off, and below the fracture a deep indentation was neatly chipped, making the whole not unlike a rude fork. Like the concave or curved scrapers of Onondaga County, it may have been employed in forming arrow shafts, though not a true scraper like them.

Fig. 8 is of a horn implement, perhaps a punch for ornamenting pottery, though of rather a late date for that. This is a Cayuga form, but they are found on other sites of the

middle of the seventeenth century. In a very old grave Mr. Adams found a slender marrow-bone, the central part shaved down into a long elliptical opening. The cavity was filled with paint, and a slender pestle for mixing paint almost closed the orifice. In this grave was a large piece of mica.

Some old burial places present curious features. In one spot an upper stratum of bones had been disturbed, but on removing a layer of soil two inches thick another would be found, and thus until the fourth bottom course was reached. Sometimes a single skeleton occupied one course, and then there might be three or four side by side. Ten or twelve would be the average in the successive burials, but in one case there were over twenty. One or more skeletons would have accompanying articles, and these were early burials.

Here is a curious and suggestive list of articles found in a Cayuga chief's grave last year by Mr. Adams: "Seventeen flints, 2 gun-flints, 6 bullets, 6 baldric beads, 1 bone harpoon, 3 buckhorn handles, 1 knife with buckhorn handle, 21 gambling flints, 3 bars of lead, 5 rubbing stones, 16 bears' tusks, 2 axes, 1 brass kettle, 2 pair shears, 4 pair bullet moulds, 2 gun-locks with flints, 47 pieces gun-locks, 2 iron shears, 32 knives and cutting implements, 1 gun, 1 pipe, 1 piece death paint (plumbago), 1 piece mica, 2 trigger guards, 1 wormer, 1 gun-cleaner, steel and 2 flints, a quantity of powder in a cloth bag, 2 melting ladles, 2,500 wampum beads." Each bar of lead weighed three pounds. The mica shows a modern as well as ancient use, and some other articles would elsewhere be thought old.

Of recent articles Mr. Adams has obtained a large number, and some of those of the Jesuit period are of much interest. Copper kettles prove much more frequent than vessels of clay, and many articles still used by the New York Indians occur. The valley of the Salmon Creek was once rich in remains, and accounts were published long ago of the large quantities of iron and brass taken thence to Auburn for sale. They were plowed up for a space of several miles in length along the bottom lands.

As in other cases, the Cayuga relics cannot all be classified, and some are found which are sufficiently puzzling. Among these are some of the ruder implements. These may be passed over now, but the foregoing account will show what may sometimes be done in a short time in a field supposed to have been exhausted.

DAYS AND NIGHTS BY THE SEA.[1]

BY FRANCIS H. HERRICK.

FOR one who has spent his life inland, a visit to the sea and especially to the tropical sea is an event to date from. The revelation of a new world awaits him. Strange forms innumerable meet him at every turn, and he soon comes to realize that the sea is the great home of life.

The simple outfit of thirty years ago is utterly inadequate for the student of nature of to-day who hopes to add anything of importance to our knowledge of the organic world. He needs not only good microscopes, drawing materials, ample aquaria and dredging apparatus, but a large assortment of chemical reagents, the uses of which in the preservation and study of living matter has almost revolutionized the science of biology.

Nearly all marine animals discharge their eggs into the water in vast numbers, and the young which are hatched from them, in most cases, lead an independent swimming life at the surface of the ocean. This locomotor larval period as it is called, may extend over weeks or months, and is shared by animals which in the adult state have the most diverse habits, such as the coral, the barnacle, and the mussel, which are firmly anchored to some solid support, the starfish and sea-urchin, the jellyfish and annelid, the crabs and prawns, the salpas and amphioxus; and also the fishes, the highest type of marine life which pass their early stages at the surface of the

[1] Part of a lecture delivered in the "University Lecture Concert Course," Jan. 31, 1889. Western Reserve University, Cleveland, Ohio.

PLATE XIX.

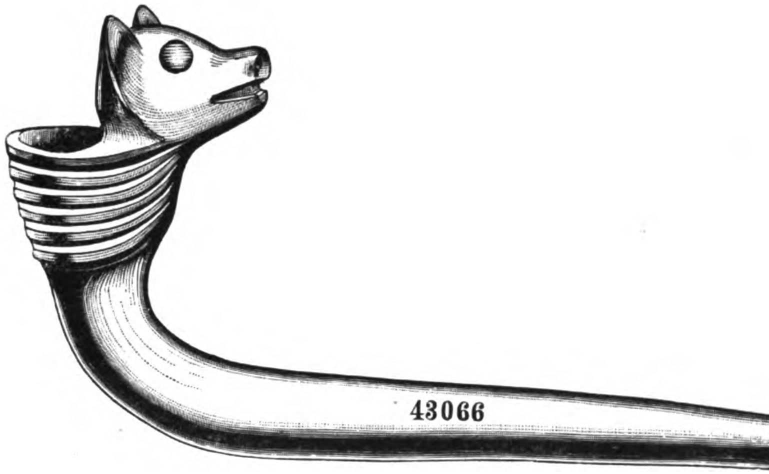

Fig. 5. Clay Pipe.

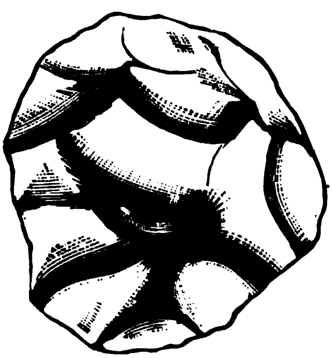

Fig. 6. Gambling Flint.

Fig. 7. Gambling Flint.

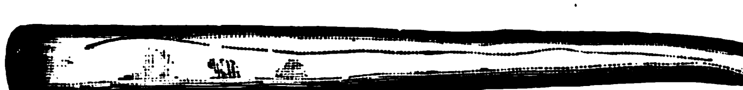

Fig. 8. Horn Implement.

CAYUGA INDIAN RELICS.

sea. The young of these and of a hundred other forms swarm in the surface water on still evenings, in countless myriads, the most delicate creatures, many of them as transparent as glass, and so small that it requires a microscope to see them. After passing through metamorphoses more wonderful than any described in the tales of Ovid, the remnant of this host which nature allows to live, takes on adult characters. The young crab or prawn after having gone by several aliases, and played as many distinct roles, sheds it skin once more, sinks to the bottom and except in point of size is indistinguishable from an adult. One would hardly have guessed that a larva like that of the mollusc with its enormous locomotory sails, and its delicate fringes of cilia, would ever develop into a sedentary slow-moving gastropod, or that the grotesque microscopic larva, shaped like a painter's easel, would ever turn into into a symmetrical starfish with its five horizontal rays.

If one spends a few hours in the gulf stream on a calm day or night, he cannot fail to be impressed by that vast stratum of living beings, which this great ocean current bears hourly upon its bosom. Once when off our southern coast, we sailed through a school of medusæ which must have covered many square miles of ocean. They were little brown bells, the size of thimbles, and the indigo water was peppered with them. We encountered them at about four o'clock in the afternoon and for more than an hour their numbers did not sensibly diminish. But at night the dark waters glow with the phosphorescence of those minute and obscure beings whose presence one would not suspect by day unless he had microscopic eyes. Through every mile that the ship ploughs her way, her bow encounters a steady stream of shooting stars. Every movement in this living water precipitates a shower of sparks, and every spark is due to an organism. There are stars of the first magnitude, like the large medusæ glowing like red-hot cannon balls, besides a whole galaxy of lesser lights.

Much of the time of a naturalist at the seaside is spent in the collection and study of these pelagic larvæ and the adult forms which they represent. A calm summer's evening when

not a ripple breaks the mirror of the surface, is best for this purpose. With a companion to take turns at rowing, or to hold the net, we glide off in the darkness to some point where a distinct current sets, or better still where two currents meet, for in such places pelagic larvæ are most abundant. The apparatus for "surface collecting" as it is called, is simple enough. It consists of a tow net made of bolting cloth or coarsely woven silk, through the meshes of which the microscopic animals cannot pass, and a bucket of sea water. The net is put out and allowed to skim the surface as the boat moves slowly through the water. If the place and time are very favorable the net soon begins to glow, as if made of platinum gauze, heated white hot, and at short intervals it is cautiously raised to the boat, and the sparks are washed off into a bucket of sea water, and the process repeated. After returning to the laboratory, the water containing the evening's catch is carefully examined by each student, who selects and preserves those particular organisms which he happens to be at work upon at the time.

If a tall beaker of this water is dipped from the bucket and held up to the light we may behold a most remarkable and fascinating sight. Every drop is teeming with life. The myrmidons of the deep are here. The young of almost every type of marine life has a representative in our glass, but so disguised are many in their undeveloped state that only the specialist may recognize them. They vary in size from half an inch long down to microscopic proportions. Some are adults. There are innumerable larvæ of crustacea, of grotesque shapes, moving with quick jerks; some with the body stuck full of spines, or with a huge straight spear growing out of the forehead; glass-like Ctenophoræ reeling through the water, propelled by encircling bands of irridescent cilia; veliger mollusks floating with sails wide spread; bead-like larvæ of annelids, which swim with rapid rotatory movement: the colorless eggs and quaint fish embryos, whose large black eyes and enormous golden yellow yolk sacs, attract the eye while their transparent body is hardly visible; the pulsa-

ting bells of ghost-like jelly-fish, rising and falling as they deliberately contract and expand their discs; the floating Siphonophoræ transparent as the air and delicate as spun glass. In the turmoil of the moment a thousand strangely beautiful forms pass rapidly before the eye.

The larvæ selected for study are carefully set aside in beakers of sea water, or in watch glasses, and it is sometimes possible to keep them alive for a number of days, and observe their transformations, but usually unless there is means of providing them with freshly aërated sea-water, this is not possible. Some forms are so delicate that one is hardly able to bring them in alive. They die as soon as caught.

Where it can be done, by far the most satisfactory method of studying the development or life history of an animal is to procure the adults and keep them under observation until they deposit their eggs. The development of the ova can then be studied with the closest detail, not only by the superficial view of the growing embryo, but by means of the sectional method which has yielded such valuable results to natural science in the past ten years.

In the case of many animals, such as fishes, "king crabs," oysters, starfish, and sea urchins, where the sexes are separate, the ripe eggs can be obtained and fertilized artificially, and the complex processes by which the highly organized fish or mollusc is slowly built up by changes which start in the germ cells, can be witnessed in all their details. Animals differ very widely in this respect however, and the vitality of the ova is connected in some cases certainly with that of the animals themselves. Starfish or Ophiurans may be sadly mutilated without killing them, and some of the molluscs are notoriously hardy. A year and a half ago I brought from the West Indies a collection of marine shells, gathered in the water or on the coral rocks on shore. They were done up in a package and sent with other collections to my home in New Hampshire. The next fall when the bundle was opened, much to my surprise a number of the univalves (*Tectarius muricatus*), were alive and crawling about. In one of our eastern colleges,

some molluscs brought from the Holy Land were placed in the college collection and duly labelled, when some of them exhibited their vitality by walking off the museum cards.

The "Horseshoe," or King Crab which anyone who goes to the Atlantic seaboard can usually find on any sand-flat, is an animal remarkable not only for its great antiquity, but for its extreme hardiness which is perhaps one cause of its great age. They are found fossil in the primary rocks, in the Cambrian and Silurian formations, and therefore excepting the Foraminifera, they are among the oldest animals known. The related trilobite has perished utterly, and a whole army of other forms, but the King Crab has existed during all these ages and has altered but little; hence we must infer that their conditions of life have been nearly uniform during this immense period. When the embryology of this animal was being studied at the Marine Laboratory of the John Hopkin's University at Beaufort, N. C., a few years ago, an attempt was made to fertilize the eggs artificially. As the ova did not at first show any of the usual signs of development, but began to swell as if undergoing decomposition, they were set aside and forgotten. In about 3 weeks from this time the dish was examined by chance, when it was seen that the young king-crabs were just leaving the shell, notwithstanding the fact that the water in which they had lived was impure, and had nearly evaporated. The following anecdote which illustrates what the adult King Crab can stand, I heard from Professor Brooks of the Johns Hopkins University. While he was studying with Louis Agassiz at Cambridge, Milne-Edwards, the renowned French naturalist sent to this country for some specimens of the American King Crab, on which he was then preparing his well known monograph. The animals as soon as captured were taken to the Cambridge laboratory and thrown under a building, where they remained some weeks, exposed to a low temperature. They were then packed up and sent abroad, and when they reached Paris, some of them were still alive. It is interesting to notice that this animal is not a Crab at all, nor indeed a Crustacean, as the recent study of its development has

most certainly shown. It is more nearly related to the Spiders.

The case is very different with the ova of many other animals, for instance the eggs of prawns such as the Lobster and the Shrimp. They are not discharged into the sea, and left to take their chances with enemies, but are attached to the body of the animal which carries them about until they hatch. In most cases they are fastened by fine threads of glue to the swimming legs, and as the constant motion of these appendages is shared by the eggs, the latter are always well aërated. If the ova are removed from the animal, they invariably die.

Some Crustacea (like the Stomatopods) lay their eggs in masses in burrows in the sand or in coral rocks, and if they are removed and placed in an aquarium, they also die. But if the habits of these animals are studied, it is found that either the male or female is always brooding over the eggs and fanning them with its legs, thus supplying the needed aëration by the currents of water set up. This process of supplying the necessary oxygen is seen in fish-hatching houses, where the eggs are laid upon shallow trays, over which a stream of water is constantly passing.

The eggs of animals like the Corals and Sea-fans can be easily obtained in the breeding season, by placing a colony of the polyps, like a piece of living coral, in a glass dish or aquarium. The minute spherical eggs or young will be discharged through the mouths of the polyps and float to the surface, when they can be skimmed off, transferred to other dishes and their development watched. With the modern appliances and methods of research, the naturalist of to-day can investigate the problems of animal life with far better success than was possible a generation ago. How is the life history of an animal written? How do we trace the numerous links in the chain of events between the one-called, apparently homogeneous egg, to the highly complex animal which produces the egg? To answer this question very briefly we may conveniently select the shrimp, although we might choose equally well a fish, a sea-urchin or a coral.

It is well known that the eggs of the higher animals, the mammals, are few in number, and that when fertilized, they are not discharged, but remain and develop in the body of the parent. Partly for this reason the embryology of the higher forms is much more difficult, but the eggs of the lower animals, like Crustacea, Corals and Starfishes, are deposited in very great numbers. The number of eggs laid by the edible Crab (*Neptunus hastatus*) of the Southern States, for instance, is estimated at 4½ millions. The eggs are not only passed out of the body, but in many cases develop quite independently of the parent. Consequently a store of food called *yolk*, is laid up in the egg, as we see in the hen's egg, for the use of the growing embryo.

We start with the fertilized germ cell the egg, although it should be remembered that there is a long series of events before this is reached. The germinal cell itself is derived from other cells in the tissues of the mother and the tissues which compose the body, are themselves derived from the egg, and this cycle is repeated generation after generation. The male germinal cell, which in fertilization unites with the ovum, has a similar origin, so that the egg, from which the animal springs is not as simple a structure as one might suppose, but a microcosm in itself, containing as it must the hereditary germs of a long and complex line of ancestors.

As a rule an egg does not develop unless it unites with another kind of cell, called the male germinal cell. This rule is however violated, in the case of the parthenogenetic insects, the Gall-wasps, Bees and Moths, and in some Crustacea, where the eggs develop without fertilization, and where the males are sometimes wanting.

The egg of the shrimp, like that of the hen or tortoise consists of a large mass of food-yolk, surrounding the more essential part of the cell,—the nucleus, as it is called, the whole being enveloped by a protective membrane, the shell. Beginning then with the single egg-cell (which, if fertilized, is of course duplex in nature,) the animal is slowly developed by the division and differentiation of its products. The nucleus and

sometimes the whole egg with it, divides into 2, 4, 8, 16 parts in geometrical ratio. The resulting cells however do not separate as in the lowest forms of life, but remain united, and do not long continue alike but become differentiated. A very complex physiological division of labor is finally established among them, and when the adult condition is reached, the body is a colony of probably many million of cells, constituting various tissues and organs, all of which work correlatively and harmoniously for the good of the whole. The adult healthy body may thus be compared to an ideal state, where the cells represent individuals or individual minds, all of which have the same faculties, although developed in different degrees. Yet all these subordinate units work together in a wonderful way for the good of a higher unit, the body or state. As the state has its executive and police officers to guard its interests and enforce obedience to its laws, so the body has the nerve cells of the nervous system, which in health regulate and coördinate the working of all the other organs.

This fundamental conception of living things, known as the Cell Theory, was announced 50 years ago. It is no longer a theory but a fact, and from it every problem in biology must proceed.

How then is it possible to follow these delicate and intricate processes by which the complex cell-state or community, which we call the animal, is developed from the egg? The changes are chiefly internal, while the eggs, which are usually of microscopic size, are frequently opaque, and the protoplasm or living matter of the cells themselves, is colorless. Difficulties such as these, however insurmountable they may have been a generation ago, have been completely overcome, and it is now an easy task to divide an egg, which we will say is 1-25 of an inch in diameter, or the size of a pin's head, into a series of 100 sections, each 1-2500 of an inch in thickness. These may then be placed in serial order on a strip of glass, and each of the 100 sections, which can now be studied with high powers of the microscope, is seen to be a picture in color, which plainly tells of the marvellous processes which have

been going on unseen in the colorless living protoplasm of the cells.

The eggs of our Shrimp are taken at short intervals during several days or weeks, so that the series will represent the whole history of growth from the egg to the young prawn. The ova are then killed and hardened by suitable reagents, and finally preserved in alcohol. They are then stained with certain dyes like carmine, hæmotoxylon, or osmic acid (which both kills, hardens, and stains protoplasm at the same time). A great step was taken in modern biology (and especially embryology) when it was discovered that protoplasm has such a remarkable affinity for the aniline and vegetable dyes. The colorless and invisible can be made to yield the secret of hidden change in colored pictures. Furthermore it is probable that certain kinds of protoplasm, or protoplasm in certain stages combines only with particular dyes.

The stained eggs are then saturated with paraffine and embedded in a block of this substance. The paraffin block is clamped in the holder of a microtome, an instrument for cutting very thin sections, and then, thanks to the property of the paraffine, each section, as soon as cut by the passage of the knife, adheres by its edge to the section following, so that a paraffine ribbon can be cut, a yard long if necessary, in which the embedded egg will now appear in the form of a series of very thin colored sections, arranged in serial order. It is then a simple matter to fix them upon a glass slide, to remove the paraffin, and to seal the whole in a drop of balsam. Thus may we bring out the hidden writing and read the secret manuscript.

We have not the time to follow in any detail the life history of an animal like the Shrimp, however interesting it might be, to see how from the simpler the complex arises, how the adult with its tissues and organs each so remarkable and often complicated in itself, arises from comparatively simple beginnings, and how the individual in its own life history repeats in an abbreviated and modified form, the history of the race. But we do well if we realize this wonder of wonders, the development

of the higher animal with its marvellous organs, the eye, the heart and brain from the egg cell. If the eye or the brain is complicated, what must we say of this unicellular germ, the egg, in which in large measure certainly, the adult structure must potentially exist.

Some may think that since the young of different animals are subjected to peculiar conditions, to varying climate, food and the like, their differences in structure may be influenced by their surroundings. But this objection is easily answered, for we can rear the eggs of such diverse forms as the fish, the sea urchin, and the oyster in the same tumbler of water, where the conditions are identical. We are thus brought face to face with the great problem of *heredity*, that is, the law by which all living things tend to resemble the parents from which they sprung, or some ancestor belonging to their immediate race, in spite of variability or adaptation to environment. That the coral polyp reaches a certain stage of development and stops, that the starfish travels by this same road but advances far beyond, the young always coming to resemble the adult; that the higher animals pass still farther along this path; that the child resembles its parents often to a trick of speech or to a shade of mental or moral character, or that sometimes the character of a preceding generation makes its appearance, is one of the most remarkable phenomena which man has observed. Marvellous as it is, it seems not to be inscrutable, and the studies of recent years are lightening its dark passages.

It may be asked, of what use is the knowledge of the structure and development of animals below man. The chief aim in natural science is to discover relations. The life history of a coral is valuable for the light it throws on the problem of all organic life. The great laws governing all living matter are the same. We can only read the complex through the simple. The lower we pass in the scale of animal and plant life, the simpler the structure, the more nearly are the problems reduced to lowest terms.

The most interesting object in nature is man, and apart from the high claims of pure science, of knowledge for its own merit,

our studies naturally come to a focus in man. The history, the welfare and the destiny of man are questions which interest all civilized people.

Biology or the natural history of living things deals with the phenomena of organic nature, and to man, its central figure it constantly returns. Morphology, the study of structure, physiology the study of function, pathology the study of disease, and medicine the study of treatment go hand in hand, and are mutually dependent. We sometimes hear well meaning though misinformed persons speak of naturalists who spend laborious years of travel and devote their lives to research as if they were bitten with the mania of discovering new species. This is, of course, a great mistake. The history of every science begins with the naming of things, but this day is long past, and as Agassiz said in one of his cabin lectures when on his way to Brazil in 1865: "This is now almost the lowest kind of scientific work." . . . . "The work of the naturalist, in our day, is to explore worlds the existence of which is already known; to investigate not to discover." . . . . "The discovery of a new species as such, does not change a feature in the science of natural history, any more than the discovery of a new asteriod changes the character of the problems to be investigated by astronomers. It is merely adding to the enumeration of objects. We should rather look for the fundamental relations among animals; the number of species we may find is of importance only so far as they explain the distribution and limitation of different genera and families, their relations to each other and to the world under which they live. Out of such investigations there looms up a deeper question for scientific men, the solution of which is to be the most important result of their work in coming generations. The origin of life is the great question of the day. How did the organic world come to be as it is?"

A generation has passed since these words were uttered, yet how true they still read! Much indeed has been accomplished in this period; the horizon of all science has widened. The germ theory of infectious disease has become a science and is

now revolutionizing the practice of medicine and surgery.

Says a well-known physician "Looking into the future in the light of recent discoveries, it does not seem impossible that a time may came when the cause of every infectious disease will be known." . . . . "What has been accomplished within the past ten years as regards knowledge of the causes, prevention, and treatment of disease far transcends what would have been regarded a quarter of a century ago as the wildest and most impossible speculation." Embryology has been enriched by the discovery of new means of research. Some of the best work in physiology has been done. Darwin's theory of the origin of species has been tested as a working hypothesis, and been found fruitful in valuable results. The work of the naturalist by its application to the economic industries of the nation can appeal to all classes. The service of the Fish Commission and of the Entomological Bureau annually save the country from great losses, and add to its resources. Our valuable food fishes are artificially raised, and the depleted pond, river or sea coast can be stocked anew. The oyster can now be reared from eggs artificially fertilized, and the young lobster has this last year been safely transported across the continent, and planted on the shores of the wide Pacific.

But the study of nature has another and less serious side, and here I refer to out-door nature as well as to in-door pursuits. It adds pleasure to life. It gives a zest and object to every walk or ride which one takes in the open air, to every camping and hunting excursion to the woods. It lengthens life, or what is the same thing, our experience, because we see just so much more of this beautiful world. Many people think that science is not only difficult but dry. This is a sad mistake. The scientific treatises which Charles Lamb would class with books that are *not* book, may be tedious to the beginner, but the student is not restricted to these or to the musty folios of the past, in making his acquaintance with animal and plant life. Technical works are not intended to be read but, like dictionaries, they are useful to consult.

"Botany," says Sir John Lubbock, "is by many regarded

as a dry science. Yet without it one may admire flowers and trees as one may admire a great man or a beautiful woman whom one meets in a crowd; but it is as a stranger. The botanist" or "one with even the slightest knowledge of that delightful science—when he goes out into the woods or into one of those fairy forests which we call fields, finds himself welcomed by a glad company of friends, every one with something interesting to tell."

The faculty of observation, so preternaturally acute in some minds like Aristotle's or Humboldt's or Darwin's, is rudimentary or dormant in a very large part of mankind. Said Emerson "if men should see the stars but once in a thousand years how would they wonder and believe!" The cheapness of the pleasure may be fatal to its enjoyment. They see only the mud and soot, where the gold and the diamond lie. They have eyes but do not use them, and like Laura Bridgman are cut off from many of the enjoyments of nature. As Lubbock well says, many still "love birds as boys do—that is, they love throwing stones at them; or wonder if they are good to eat, as the Esquimaux asked of the watch; or treat them as certain devout Afreedee villagers are said to have treated a descendant of the Prophet—killed him in order to worship at his tomb."

The study of Natural History, or Biology, if we use the newer term not only awakens the mind by cultivating the faculty of observation, but widens our enjoyments and enlists our sympathies, giving us a new and human interest in the manifold living beings around us which hold life by the same tenure as ourselves. It also fits in well with those instincts which we seem to have inherited from primitive man, with hunting and fishing, and also with travel, the facilities for which were never greater than in our day, and with short vacations in the country, all of which it enhances in interest, and to all of which it insures success.

Says T. Digby Pigott, "Of all the poor creatures, whose fate it was to be strangled or battered to death by Hercules, there was only one who made a really good stand up fight, and at one time seemed to be fairly beating him. He was Antaeus,

the son of the earth. Every time that he fell and touched his mother—we should say 'ran out to the country'—he came up again with fighting powers renewed. It was not till Hercules found out his secret and held him up, never letting him fall—we should say 'stopped his Saturdays till Mondays out of town'—that he quite broke him down. It is a myth in which the wisdom of the ancients is written for our admonition, in whom the ends of the world have come, the lesson that the best cure for a tired head and irritable nerves is the touch of Mother Nature,—to escape from the din of the city, and the everlasting cry of 'extra specials,' and lose oneself if only for a day among the wild creation."

The life and structure of the simplest animal or plant is a marvel, the greatness of which we are utterly incapable to conceive, and one of the plainest teachings of everyday science is that mere *size* is no test of importance. One might suppose that the microscopic cell was too small to be taken into account at all and to spend days and nights in the study of such objects must be a stupid sort of amusement: But an Elephant is only an aggregate of these little cells, and the nefarious microbe or floating spore, so small that it takes the highest powers of the best microscopes to clearly discern it; and so light that it floats in myriads on the wings of the viewless air, it is also a cell, and unfortunatly for man, when breathed into his lungs may be capable of multiplying indefinitely, and producing terrible disease and death. The coral polyp, insignificant enough when contemplated singly, is able to girdle the globe, only give it the time and favorable conditions. The leaven however small, which is hid in the meal, will in due time leaven the whole lump.

The mountains were not upheaved in a day. The hills have been carried by the touch of the rain-drop, and the flow of the ice stream and river. The smallest fragment of coral rock, which is among the youngest of modern formations, is but a phase in the endless cycles through which all matter runs. The rain united with the carbonic acid of the earth and air divides the solid rock, and the rivers from the four corners of

the earth carry down the molecules of lime in a ceaseless current with the common sea, where says Dana "after circulating over thousands of miles and for unknown times, they are brought to light and rendered tangible again by the incessant labors of millions of minute living gelatinous bodies, and by these insignificant organisms the lime is built up again into masses almost rivalling the original in dimensions and importance, but losing in this, its new dress, all traces of its divine origin and divine age." Thus he says, "we may have rocks from the snow-covered summits of the Himalayas, the limestones of the burning plains of India, and the strata of inaccessible China, removed from their respective districts—into the great common receptacle."

Modern science teaches that the small has produced the great, that the earth as we now know it has been fashioned by forces which are in operation to-day. The small indeed may be the most significant, and size in the vocabulary of biology at least may be an unimportant term.

SOLENISCUS: ITS GENERIC CHARACTERS AND RELATIONS.

BY CHARLES R. KEYES.

THE genus Soleniscus was established by Meek and Worthen to include gastropod shells closely allied to the widely known Macrocheilus; and said to be distinguished from the latter chiefly by the presence of a single elevated fold on the columella and by being produced anteriorly into a short canal. The authors described under this genus but a single species—*S. typicus.* Miller,[1] however, in 1877, included also *Macrocheilus hallanus* Geinitz. Four years later White[2] described from New Mexico *S. planus* and *S. brevis*; and afterwards[3] referred to the genus five other species which had orig-

[1] Am. Palæ. Foss., p. 162.

[2] Exp. and Sur. west 100th Merid., Supp. to Vol. iii.

[3] Ind. Geol. Rep. for 1883.

inally been placed under Macrocheilus. Upon the characters mentioned, principally, Macrocheilus and Soleniscus have been separated. The former was considered to embrace all the Devonian and a few of the Carboniferous forms described under the genus; and the latter the majority of the American Carboniferous species, generally known under the other generic title.

Of Macrocheilus there have been described from Europe nearly fifty species; two-fifths of which are from the Devonian. From America thirty-four species have been named; of these five are from the Devonian, three from the Lower Carboniferous and the rest from the Coal Measures. The American Devonian forms are exceedingly rare; and nothing beyond the original descriptions is known in regard to them. With one exception, they have been, in all probability, erroneously referred to the genus. The species described from the Carboniferous of North America will doubtless be reduced, after a careful comparison, to one-half the number now recognized.

Macrocheilus was founded by Phillips[1] in 1841, and under it were enumerated *Buccinum breve* Sow., *B. imbricatum* Phillips, *B. acutum* Sowerby and three other species. Phillips, however, expressly remarked that the first two of these properly belong to other groups, and that he regarded the third form as more typical. *B. acutum* Sow. hence becomes the type of the genus; and was thus considered by de Koninck and other European writers. An examination of numerous specimens of *Macrocheilus* (*Buccinum*) *acutum* shows that the shell possesses a more or less thickened lip, and a prominent revolving fold on the columella. De Koninck[2] long ago recognized this fact, stating that "La columelle est garnie d'un pli oblique et quelquefois de deux; le second pli n'est que faiblement exprimé et ne s'observe bien que dans les échantillons d'une conservation parfaite." It thus appears that the form described as *Buccinum acutum* by Sowerby is in all respects a typical Soleniscus and that therefore that genus and Macrocheilus are identical.

[1] Palæ. Foss. Cornwall, p. 103.

[2] Desc. des Anim. Foss. de Belgique, p. 474. 1844.

But Phillip's term Macrocheilus was preoccupied by Hope, in 1838, for a genus of insects and therefore becomes unavailable. Conrad, in 1842, proposed Plectostylus for a group of fossil gastropods which evidently belonged to Macrocheilus; but this name also had been used by Beck five years before. In 1860, Meek and Worthen founded the genus Soleniscus, for certain paleozoic shells which now appear to be very closely related to the type of Macrocheilus. Inasmuch as the latter term had been previously used, Bayle, in 1879, substituted the name Duncania, which he subsequently[1] changed to Macrochilina. The generic title *Soleniscus* therefore takes precedence for the *Macrocheilus* group, typified by *Buccinum acutum* Sow., and *S. typicus* M. and W., the synonymy being as follows:

Buccinum Sowerby, etc., [*in part*] (*non* Linné).

1841. *Macrocheilus* Phillips. Palæ. Foss. Corn., p. 103. (*non* Hope, 1838, Coleoptera).

1842. *Plectostylus* Conrad. *Jour. Acad. Nat. Sci.*, Phila., Vol. viii , p. 275. (*non* Beck, 1837).

1860. *Soleniscus* Meek and Worthen. *Proc. Acad. Nat. Sci.*, Phila., 1860. p. 467.

1879. *Duncania* Bayle. *Jour. de Conchyliologie*, Vol. xix., p. 35.

1880. *Macrochilina* Bayle. Ibid., Vol. xx., p. 241.

If the assumed differences in certain characters of the Devonic and earlier Carboniferous species described under Macrocheilus are real, and are of sufficient import to separate generically this group from *Soleniscus*, as has been suggested, some other generic term must be employed to designate the group. In this case, Bayle's name Macrochilina might easily be made to answer; but it is very doubtful whether this would be expedient. A more advisable plan would be to transfer to other genera the several species described under Macrocheilus, but which perhaps do not properly belong there. In this way it is thought that Soleniscus will form naturally a very compact and easily distinguishable group, at least in so far as the American species are concerned, and apparently also the European.

Soleniscus consequently embraces paleozoic gastropods

[1] Jour. de Conchyliologie, (3), Vol. xx., p. 241. 1880.

having the shell fusiform or subovoid; the spire always acute; body whorl relatively rather large; aperture suboval, rounded anteriorly, angular behind; labrum thin; columella imperforate, and provided with a more or less distinct fold; surface smooth.

As observed by White, the twisted ridge on the columella is scarcely discernible in the perfect shell until the outer lip is broken away, when it is seen to become more and more pronounced as it passes inward from the aperture. By the removal of the lip the anterior portion of the shell seems more extended than in the unbroken specimen; and this feature was made unduly conspicuous by Meek and Worthen when they established the genus under consideration. Although seldom noticed on account of the apertural part of the shell being filled with matrix, a more or less well defined columellar fold is observable in the most of the hitherto called *Macrocheili*. This plication, very slightly developed in some forms, passes, in the various species, by imperceptible gradations into a conspicuous revolving ridge as exhibited in *S. typicus*. The callus of the inner lip varies so greatly, according to the state of preservation and the locality, that only in a general way can it be relied upon as of generic importance.

The following species, originally described as Macrocheili may be considered as properly belonging to Soleniscus:

S. typicus M. & W.	*S.* (?) *attenuatus* Hall.
S. acutus Sow.	*S. gracilis* Cox.
S. humilis Keyes.	*S. klipparti* Meek.
S. kansasensis Swallow.	*S. altonensis* Worthen.
S. hallanus Geinitz.	*S. newberryi* Stevens.
S. planus White.	*S. paludinæformis* Hall.
S. brevis[1] White.	*S. carinatus* Stevens.

With two or three exceptions, perhaps, the other described species of the fusiform group from the American Carboniferous are apparently synonymous with one or another of those here enumerated. The genus probably includes besides *S. acutus*

[1] *S. brevis* White is synonymous with *Macrocheilus ventricosum* Hall, but the latter was preoccupied by Goldfuss (*Pet. Germ.*, *Dritter Theil*, p. 29, 1841-44).

Sow. the majority of European forms now known under Bayle's Macrochilina.

In America, Soleniscus is one of the most characteristic genera of the Upper Carboniferous. The forms fall naturally into two categories: (*a*) the elongate or fusiform shells; and (*b*) the subovoid or subglobose varieties.

Those of the first group predominated in the earlier part of the epoch, while those of the second were more abundant in the latter part. The fusiform species occur most plentifully in the bituminous shales immediately associated with the coal seams. This would indicate that these gastropods were marsh or brackish-water forms, rather than denizens of the open sea. The subovoid forms are more commonly found in calcareous strata and were probably more strictly marine than the other members of the genus. Aside from the apparent difference in *optimum habitat* the shells of the two sections present some distinctive structural features which, taking all things into consideration, may eventually warrant a generic separation. This might with advantage be done with the American species, but whether it could be satisfactorily applied to the numerous foreign forms has not, as yet, been determined. The shells of the first category, compared with those of the second, have the volutions much more convex, the spire greatly depressed, the body whorl relatively much larger, and the aperture correspondingly ample, while the columellar ridge is usually obtuse and sometimes scarcely defined.

EXPLANATION OF PLATE XX.

Figs. 1, 2, 3. *Soleniscus acutus* Sow. 4. *S. humilis* Keyes. 5. *S. newberryi ?* Stevens. 6. *S. gracilis* Cox. 7. *S. attenuatus* Hall. 8. *S. typicus* M. & W. 9. *S. attenuatus ?* Hall. 10. *M. primogenium* Conrad. 11. *S. klipparti* Meek. 12, 14. *S. brevis* White. 13. *M. intercalare* M. & W. 15. *M. ponderosum* Swallow. 16. *S. paludinæformis* Hall. 17. *M. texanum ?* Shumard. 18. *S. planus* White. Last five after White.

RECENT LITERATURE.

HAECKEL'S REPORT ON THE SIPHONOPHORÆ COLLECTED BY H. M. S. CHALLENGER during the years 1873–1876.—This report forms Part lxxvii. of the zoological series of reports, and consists of 383 pages and fifty lithographic and chromo-lithographic plates. The author's long-continued and elaborate investigations of living Siphonophoræ and medusæ in the Mediterranean, Atlantic and Indian Oceans have enabled him to make it a generic monograph of the class. He distinguishes seventy-five genera, all clearly defined and described at length, containing 245 species. The plates are exquisite; remarkable both for beauty and elaborate finish of detail.

The following synopsis shows the distribution of the species.

Family.	*Genera.*	*Species.*
ORDER I. DISCONECTÆ.		
Discaliidæ	2	5
Porpitidæ	4	15
Velellidæ	3	16
ORDER II. CALYCONECTÆ.		
Eudoxiidæ	8	28
Ersæidae	2	4
Monophyidæ	6	17
Diphyidæ	8	35
Desmophyidæ	2	2
Polyphyidæ	3	8
ORDER III. PHYRONECTÆ.		
Circaliidæ	1	3
Anthoriidæ	2	3
Apolemiidæ	3	4
Agalmidæ	10	32
Forskaliidæ	4	11
Nectaliidæ	2	2
Discolabidæ	3	11
Anthophyridæ	4	9
ORDER IV. AURONECTÆ.		
Stephaliidæ	2	2
Rhodaliidæ	2	3
ORDER V. CYSTONECTÆ.		
Cystalidiæ	1	2
Rhizophyridæ	6	11
Salaciidæ	1	2
Epibulidæ	2	4
Physaliidæ	4	11

WHITE'S REVIEW OF THE FOSSIL OSTREIDÆ OF NORTH AMERICA,[1] and a Comparison of the Fossil Forms with the Living Forms.—This is a compilation of material already published, arranged to show the geological history of the oyster family, addressed rather to the general reader than to the special student. The author recognizes three genera, and a sub-genus among fossil forms, but groups all the living species under one genus—Ostrea proper. Mr. Ryder contrib-

[1] A Review of the Fossil Ostreidæ of North America, and a Comparison of the Fossil with the Living Forms. By Charles A. White, M.D. With Appendices by Prof. Angelo Heilprin and Mr. John A. Ryder. Extract from the Fourth Annual Report U. S. Geol. Survey.

utes as an appendix an interesting sketch of the life history of the oyster. Of the forty-eight plates which accompany the paper ten, are excellent drawings of living species, so that the reader can compare for himself the fossil and the recent forms. A second appendix, North American Tertiary Ostreidæ, by Prof. Angelo Heilprin, completes the review.

RUSSELL'S GEOLOGICAL RECONNAISSANCE OF SOUTHERN OREGON.[1]—This paper is the result of the author's own observations in this region, and his conclusions are summed up as follows :

"The rocks are almost entirely igneous. The basins are orographic valleys of the Great Basin type. During the Plistocene the excess of precipitation over evaporation was greater than at present. A number of the Plistocene lakes did not overflow. Many of the lakes which now occupy basins of extensive Plistocene lakes that did not find an outlet are either fresh, or hold but a small amount of mineral matter in solution. Many of the basins now occupied by arid deserts were then filled with lakes. No glaciers existed during the Plistocene period in that part of Oregon east of the Cascade Mountains; and south of the forty-fourth parallel."

The paper is illustrated by two excellent maps and several cuts of sections in different localities.

THE PELAGIC STAGE OF YOUNG FISHES, by Agassiz and Whitman.[2]—This memoir is a continuation of the papers on the young stages of osseous fishes commenced by Mr. Agassiz in 1877, and is devoted to descriptive sketches of the different fish eggs and young fishes that have come under the author's notice. As far as possible figures of the characteristic stages of each species have been given, and many of the sketches supplement those formerly published by Mr. Agassiz. There is added a synoptic table of the characters of various eggs and young fishes with reference to the plates where they are figured, which will enable the student to identify them with little difficulty.

WRIGHT ON THE SKULL AND AUDITORY ORGAN OF THE SILUROID HYPOPHTHALMUS.[3]—The object of this paper is to

[1] A Geological Reconnaissance in Southern Oregon. By Israel C. Russell. Extract from the Fourth Annual Report U. S. Geol. Survey, 1884.

[2] The Pelagic Stages of Young Fishes. By Alexander Agassiz and C. O. Whitman. With nineteen plates. Extract from the Memoirs of the Museum of Comparative Zoölogy, Vol. xiv., No. 1, Part i., 1885.

[3] On the Skull and Auditory Organ of the Siluroid Hypophthalmus. By R. Ramsay Wright, University College, Toronto. Extract Trans. Roy. Soc., Canada, 1885.

show that Hypophthalmus possesses an air-bladder connected with the auditory organ by intervention of a Weberian apparatus, formed of parts of the anterior vertebræ, modified after precisely the same plan as in the other siluroids ; but that the apparatus in question and air-bladder exhibit a reduction recalling that in the genera *Loricaria* and *Hypostomus*. It is enclosed by an extension of the occipital bone, which explains why it has been overlooked by naturalists hitherto. The author bases his conclusions on a series of sections, selections from which are represented in three plates which accompany the paper.

RECENT BOOKS AND PAMPHLETS.

Agassiz, A.—The Coral Reefs of the Hawaiian Islands. Bull. of Museum of Comparative Zoology, Vol. xvii., No. 3. From the Author.

Allen, J. A.—Notes on a Collection of Birds from Quito, Ecuador. List of Birds Collected in Bolivia by Dr. H. H. Rusby, with Field Notes by the Collector. Extracts from Bull. Am. Mus. Hist., Vol. ii., No. 2. From the Author.

Annual Report of State Geologist of New Jersey, 1888. From George Cook, State Geologist.

Barrois, Chas.—Observations sur la Constitution Géologique de l' ouest de la Bretagne. Extract des Annales de la Société Géologique du Nord, T. xvi., séance du 7 Nov., 1888. From the Author.

Bates, H. H.—Discontinuities in Nature's Methods. Extract from the American Anthropologist, April, 1888. From the Author.

Boulanger, G. A.—An Account of the Fishes Obtained by Surgeon-Major A. S. G. Jayakar, at Muscat, East Coast of Arabia. Extract from the Proceedings of the London Zoöl. Soc., Dec. 20, 1887. From the Author.

Branner, John C.—Geology of Fernando de Noronha. Extract from Am. Jour. of Science, Vol. xxxvii., Feb., 1889. From the Author.

Brongniart, Charles.—Sur un Nouveau Poisson fossile du terrain houiller de Commentry (Allier) *Pleuracanthus Gaudryi.*

————Sur un Nouvel insecte fossile des terrains carboniféres de Commentry (Allier) et sur la faune entomologique du terrain houiller. Extracts Bull. de la Société Géologique de France, Troisiéme série. Tome seizieme. From the Author.

Bulletin No. 4. Penn. State College. Agricultural Station, July, 1888.

Campbell, J. P.—Biology and its Place in a Liberal Education. From the Author.

Cook, A. J.—The Silo and Silage. From the Author.

Coulter, John M.—Plant Roots. Extract from Northwest Agriculturalist, Vol. ii., No. 3.

Darapsky, L.—La Lengua Araucana. Publicado en la Revista de Artes y Letras. From the Author.

Derby, O. A.—Occurrence of Monazite as an Accessory Element in Rocks. Extract from Am. Journ. Science, Vol. xxxvii., Feb., 1889. From the Author.

Dollo, Louis.—Sur le Genre Euclastes. Extrait des Annales de la Société Géologique du Nord, T. xv., p. 114, séance du 7 Mars, 1888.

Edwards, W. H.—Description of the Preparatory Stages of *Arge galathea* Linn, with Notes on Certain *Satyrinæ*. Extract from the Canadian Entomologist, Vol. xxi. From the Author.

Farlow, W. G.—Memoir of Asa Gray. Read before the National Academy, April 17, 1889. From the Author.

Frederico, Leon.—La Lutte pour l'Existense Chez les Animaux Marins. From the Editors.

Gooch, F. A. and *Whitfield, J. E.*—Analyses of Waters of the Yellowstone National Park. Bull. of the U. S. Geol. Survey. From Department of the Interior.

Hay, O. P.—The Amphibians and Reptiles of Indiana. Extract from Ind. Agricult. Report, 1886. From the Author.

Hector, James.—Reports of Geological Explorations During 1885. Bull. of Colonial Museum and Geological Survey of New Zealand. From the Author.

Henshaw, Henry Wetherbee.—Who are the American Indians? Reprint from the American Anthropologist. From the Author.

Hobbs, W. H.—On the Petrographical Character of a Dike of Diabase in the Boston Basin. Bull. of Harvard Museum of Comparative Zoölogy. From Alexander Agassiz.

Husted, M. C.—Hay Fever: Its Treatment Physiologically and Pathologically Considered. Extract from Journ. of New York Microscopical Society. From the Author.

Jackson, Robt. T.—The Development of the Oyster with Remarks on Allied Genera. Extract from Proceedings of the Boston Society of Natural History. From the Author.

Jordan, David and *Goss, David.*—A Review of the Pleuronectidæ of America and Europe. From the Authors.

Knowlton, F. H.—The Fossil Wood and Lignites of the Potomac Formation. Extract from the Am. Geol., Vol. iii., No. 2, Feb., 1889. From the Author.

Kuntz, G. F.—Precious Stones, Gems and Decorative Stones in Canada and British America. Reprint from 1887 Report Dep't Mineral Statistics, Geol. Survey of Canada.

Macloskie, G.—The Poison-Apparatus of the Mosquito. Extract from the Am. Nat., Oct., 1888. Concessions to Science. From the Author.

McGee, W. J.—Notes on the Geology of Macon Co., Missouri. Extract from Acad. Sci., St. Louis, Vol. v., No. 1. From the Author.

Moreno, Francisco P.—Informe Preliminar de los progressos del Museo La Plata, durante el primer semestre de 1888. From the Author.

New Zealand Colonial Museum and Geological Survey. Twenty-second Annual Report. From the Director.

Osborn, H. F.—Evolution of Mammalian Molars to and From the Tritubercular Type. Reprint from the Am. Nat., December, 1888. From the Author.

Penrose, R. A. F—Nature and Origin of Deposits of Phosphate of Lime. Bull. of U. S. Geol. Survey. From Department of the Interior.

Potts, Wm. — Evolution of Vegetal Life. Extract from Modern Science Essayist, Vol. i., No. 5. From the Ideal Publishing Co.

Proceedings of the Department of Superintendence of the National Educational Ass'n., Feb. 14 16, 1888.

Purdie, Alex.—The Anatomy of the Common Mussels *Mytilus latus*, *M. edulis* and *M. magellanicus*. Bull. of Col. Museum and Geol. Survey of New Zealand. From James Hector, Director.

Reports for the Year 1886–7, 1887-8, Presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Schlosser, Max.—Ueber die Beziehungen deraus gestorbenen Säugetierfaunen und ihr Verhältniss zur Säugetierfauna der Gegenwart, Sonderabdruck aus dem Biologischen Centralblatt, Bd. viii., No. 19, 1 Dec., 1888. From the Author.

Shufeldt, R. W.—Osteology of *Circus hudsonius.* Reprint from the Journal of Comparative Medicine and Surgery. From the Author.

Swinhoe, C. Col.—Catalogue of the Moths of India, Groups Pyrales and Geometrites. From the Trustees of the Indian Museum.

Taylor, Thomas.—Food Products. Reprint from Annual Report of U. S. Department of Agriculture. From the Author.

Thomas, Cyrus.—Aids to the Study of the Maya Codices. Extract from the Sixth Annual Report of the Bureau of Ethnology.

Walcott, Charles.—Description of New Genera and Species of Fossils from the Middle Cambrian. Advance sheets issued June 11, 1889. Proceedings of the U. S. Nat. Museum. From the Author.

Will, Ludwig.—Entwickelungsgeschichte der viviparen Aphiden. Separatabdruck aus den Zoologischen Jahrbüch. From the Author.

Winchell, N. H.—The Geological and Natural History Survey of Minnesota. Report for 1887. From the Minn. Geol. Survey.

Woodward, A.—Preliminary List of the Foraminitera from the Post Pliocene Sand at Santa Barbara, Cal. Extract from the Journ- of New York Microscopical Soc. From the Author.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

ASIA, ETC.—THE KE ARCHIPELAGO.—The small Ke Archipelago, in 130″-55′-33°.15″ E. longitude and 5°-10′ to 6°-10′ S. latitude is described in the Proceedings of the Royal Geographical Society by the brothers G. and A. Langen. The two largest islands are Nuhuroa or Little Ke and Nuhujund or Great Key, at the Southern extremity of the group. To the west of these or near Little Ke are many smaller islands. Great Ke is of volcanic formation, and contains eminences from 700 to 1,000 metres above sea-level. An earthquake in April, 1884, seems to have considerably diminished its size, and given origin to several islands around it.

[1] This department is edited by W. N. Lockington, Philadelphia.

The soil of Nuhuroa and the other islands is coral with a little quartz. Nuhuroa contains the only perennial stream, which is voluminous, singularly fresh, and rises in the centre of the island, so that the writers suppose that a subterranean basin, fed from springs on Great Ke or even in New Guinea, must exist. The population of the group in 1870 was 21,000 but small-pox reduced it in 1881 to 19,456. The greater part of the people reside in Nuhujund. About a third are Mahometans. The group belongs to Holland, but is in the hands of a German Colonizing Society.

AFRICA.—THE BASHILANGE.—Lieut. H. Wissmann has published in *Petermann's Mitteilungen* (xii. 1888) a short monograph of the people known as the Bashilangi who number in all about 1,400,000, and inhabit the country between the Kasi, and the Lubi, and affluent of the Sankura. These Bashilangi are the product of the mixture of the ancient people, of the district with the invading Baluba, who came from the S. E. They are divided into four tribes, the Bashilamboa, about 560,000 strong, who occupy the western third of the territory; the Bashilambembele, 420,000 strong; the Bashilacassanga to the S. number 280,000; and the Bena Luntu northwards, 40,000. With the exception of the Bena Luntu, who are real savages, and live in family aggregations, the Bashilange are grouped in towns, and by the efforts of Calamba Mukengke, new head chief, have acquired a certain degree of civilization. Their country is about twice the size of Sicily, is well watered, and not very mountainous.

BURMA AND MANIPUR.—Col. R. G. Woodthorpe has forwarded the Royal Geographical Society of London an account of his work in and around the little known district of Manipur, where 2,800 square miles were triangulated by his surveyor, Mr. Ogle. The Brahmaputra at this part of its course flows generally parallel to the hills which separate, first, Assam from Cackar, and then Assam from Burma. These hills, increasing in height, finally culminate in lofty peaks, which singularly enough, are not on the main range, but upon spurs running out from it. Saramethè, the loftiest of these, rises to 13,000 feet. Toward the south these hill ranges part Manipur from the Lushai country, and then separate Burma from Chittagoriq. Northeast, as far as the Patkoi Pass they form the watershed between Assam and Burma. Beyond Savamethi the peaks gradually diminish in height to Maium Peak, which is only 7,000 feet. Here a drop of 3,000 feet occurs, the range narrows, and the Patkoi Pass offers a

means of communication between Upper Assam and Upper Burma.

At about 25°-20′ the Chindwin River receives the Tuzu, a considerable tributary, but the exact point of junction has not yet been observed. The Tuzu flows from the northeast, and its destination seemed problematical, since its valley appeared to be shut in on both sides by lofty peaks through which no exit was possible. Col. Woodthorpe, however, discovered that the river, after joining another stream coming from the southwest, turns off at right angles, and makes its way through a magnificent gorge between Saramcthi and another mountain 11,000 ft. high. The teak forests of the Chindwin River are very valuable, and are exploited by an Angle-Indian Company. King Thebaw's repudiation of his agreement with this company was one of the causes of the war that led to the annexation of Burma.

South of Manipur and West of Burma, lies a mass of lofty hills, inhabited by several closely allied tribes, among whom are the Chins.

AMERICA.—THE LIMITS OF VENEZULA AND BRAZIL.—Count E. Stradelli has furnished the *Bolletino della Societa Geographica Italiana* (Aug. and Sept., 1888, Jan'y, 1889) with an interesting account of his journeys in Brazil. The January issue contains the trip from Cucahy to Manaos. In the course of this article the dividing line between Brazil and Venezuela is given. This line commences at the principal source of the Memagui, an affluent of the Haguieni, which latter is a tributary of the Rio Negro. The point is 2°-1′-29.3′ N. latitude and 70°-34′-57.65″ W. longitude. Disputed territory extends farther west, but here the Colombian, Republic and Ecuador have claims. The boundary follows the watershed to 70°-20′-44.11″ W. longitude, thence goes to the sources of the Macacuny in 1°-12′-3″ N. latitude, and 69°-22′-35″ W. longitude, descends the Rio Negro to 78°-34′-18.50″ W. longitude thence goes straight to the Serro Cupy, and follows the water-parting by the Mountains Imeri, Tapyra Pecô, and Curupira. Hence it inclines to the north, following the Parima range which divides the basin of the Rio Branco from that of the Orinoco. At the Serro Maschiati, 4°-31′ N. latitude and 47°-9′-35″ W. longitude, it re-assumes the east and west direction along the Pacaraima range. It passes by Mont. Piauassu in 3°-32′-24″ N. latitude, between the rivers Uraricàparà and Auapira, and Mount Railroad Roraina, and thence to the confines of British Guiana. Most of this boundary runs through an inhospitable and unexplored country.

FONTANA'S EXPLORATIONS IN PATAGONIA.—The Italian explorer Fontana seems to have added considerably to the knowledge of the rivers of Argentine Patagonia. The Stalufu or Stanlufu is identical with the Corcovado, runs over a very sandy bed and is bordered with thick forests of beech and pines, rarely interrupted by meadows. Slightly to the south of this river the Carrenliefie runs directly into the Ocean near Point Hualà. The Corcovado is a plentiful stream, fed in its upper course by *six* affluents, the principal of which is called by the natives Uncaparia. Forty-one less important streams were discovered, among them the Quemquemtreu, Maritea and Pichi-Leufu (*the orthography is Italian*) also six before unknown lakes.

GEOGRAPHICAL NEWS.—The latest Stieler's Hand-Atlas has a map of Africa in seven sheets, upon a scale of 1–10,000,000 with all the latest changes. *Petermann's Mitteilungen* (35 Band. 1889, iv.) gives a list of the principal authorities drawn upon.

O. F. EHLERS states that he could find no trace of the presence of a crater upon the summit of Kibo (Kilimanjaro) which he estimates at upwards of 6,000 metres in elevation.

W. J. ORCHER, British Vice-Consul at Cheng-Mai or Zimme, has made an excursion to Cheng-tung, a market and thoroughfare about 200 miles to the Northeast of the former place, situated on a platform some 2,700 feet above the sea. The soil around is poor and but little cultivated, and the place owes what prosperity it possesses to its position.

Dr. BAUMAN, who accompanied Dr. Meyer, speaks of the good climate of the mountainous country of Uambara, between Pangaua and Umba in East Africa. The land is a mass of crystalline rock, covered partly with forest, partly with savanna, in places without vegetation. The Wachamba are the principal people and build two sorts of villages, one on slight elevations in valleys, with two concentric stockades and circular fences; the other on almost inacessible heights. They are agricultural, and are nominally Mussulmens. The Wachugu to the north are a taller people, and speak a different tongue; their houses are similiar, but they are almost entirely pastoral.

H. JOHNSTONE states that the difficulties encountered by the Deutsche Ostafrikanische Gesellschaft are chiefly due to the

efforts made by that company to diminish the influence of the Banyans or East Indian merchants, who are the most honest and enterprising traders of these parts. The English company will take care to avoid this mistake. The number of East Indians now residing in Zanzibar amounts to 7,000. The Banyans proper antedate the Portuguese in these parts.

H. TROGNOTZ gives the following as the correct areas of the countries of South America according to the latest data:

Brazil	8,361,350	Peru	1,137,000
Dutch Guiana	78,900	Bolivia	1,334,200
French Guiana	129,100	Chili	776,000
British Guiana	229,600	Argentine Republic	2,789,400
Venezuela	1,043,900	Uruguay	178,700
Columbia	1,203,100	Paraguay	253,100
Ecuador	299,600		
			17,813,950

This is exlcusive of the Falkland and Galapagos Islands.

GEOLOGY AND PALÆONTOLOGY.

PRESTWICH ON UNDERGROUND TEMPERATURES.[1]—The author treats the subject solely from the geological point of view. He gives tables of temperatures of coal mines, of mineral mines, of artesian wells, and bore-holes, and of tunnels. After rejecting all doubtful and uncertain cases he obtains the following values for their several gradients:

	Thermometric gradient, per 1° Fahr.
Coal mines	49.5 feet.
Mineral mines	43.2 "
Artesian wells	50.0 "

The mean of the three thus gives a general thermometric gradient of 47.5 feet per degree. In view, however, of the many causes which have interfered with the value of even the best observations, the author thinks it may be a question whether a general average gradient of 45 feet per degree would not be nearer the true normal.

[1] On Underground Temperatures, with Observations on the Conductivity of Rocks; On the Thermal Effects of Saturation and Inhibition; and On a Special Source of Heat in Mountain Ranges. By Joseph Prestwich, M. A., F. R. S. Extract from Proc. Roy. Soc., 1886.

DAVIDSON'S MONOGRAPH OF RECENT BRACHIOPODA.[1]—During the last hundred years the recent Brachiopoda have attracted considerable attention, and a large number of valuable papers have been published upon them, but no satisfactory general monograph treating of the shell and animal *conjointly* has appeared. This omission Davidson has supplied. The literature of the subject is voluminous and the labor of collating and revising alone has been enormous, but the result is a book the student will appreciate. The descriptions are characterized by a clearness and precision that shows the master. The numerous plates drawn by the author are exceptionally fine.

To Miss Agnes Crane is due the credit of editing this able work. Previous to Dr. Davidson's lamented death Miss Crane had been studying the Brachiopoda under his guidance, and at his request the proof-sheets of this memoir were read by her on the author's behalf.

BARROIS' FAUNE DU CALCAIRE D'ERBRAY[2]—A large quarto of 346 pages and 17 plates. After a brief introduction, in which the author gives his views of the formation of the *Calcaire d'Erbray*, follow five chapters devoted respectively to the Stratigraphy; the Description of 200 Species of Invertebrate fossils found in the *Calcaire d'Erbray*; Discussion of Former Works on the Fauna of Erbray; a Comparison of the Fauna of *Calcaire d'Erbray*, with Equivalent Faunas of Other Regions; General Considerations on the Fauna of *Erbray*. In conclusion the author remarks: "Les calcaires on plutôt les récifs coralliens du Harz, d'Erbray, appartiennent pour nous, à l'étage Gedinnien; ceux de Bretagne et d'Espagne, à l'étage Coblenzien; ceux de Cabrières à l'étage Eifélien; ceux des Ardennes, aux étage Gèvétien et Frasnien. L'identité de leurs conditions de formation a pu, a dû méme dans certains cas, donner aux faunes suscessives de ces calcaires plus d'analogies entre elles, qu'avec les faunes synchroniques de faciès different."

GAUDRY SUR LES DIMENSIONS GIGANTESQUES DE QUELQUES MAMMI FERES FOSSILES[3]—A short paper in which the

[1]A Monograph of Recent Brachiopoda, by Thomas Davidson. Extract from the Trans. Linnean Soc. of London, Vol. iv., part 1, 1886.

[2] Faune du Calcaire d' Erbray. Par Charles Barrois. Contribution à l'Etude du Terrain Devonien de l'Ouest de la France. 1889.

[3] Sur les dimensions gigantesques de quelques Mammiféres fossiles. Par M. Albert Gaudry. Extrait des Comptes rendus des Séances de l' Académie des Sciences t. CVII, 1888.

author gives the following table of the comparative size of some of the fossil mammalia:

Premier rang.......................*Dinotherium giganteum*
du Miocene superieure de l'Attique.

Deuxième rang.........................*Elephas antiquus*
du quaternaire (phase chaude) des environs de Paris.

Troisième rang.......................*Elephas meridionalis*
du pliocene superieure de Durfort.

Quatrième rang.....................*Mastodon americanus*
du plistocene des Etats-Unis.

Cinquième rang......................*Elephas primigenius*
du plistocene de Siberie (phase froide); et Eléphants actuels.

THE PLISTOCENE LAKE OF NEBRASKA.—Prof. J. E. Todd (*Proceedings Am. Association for Adv. of Science*) calls attention to several facts, hitherto unpublished, which indicate that eastern Nebraska, western Iowa, and south-east Dakota were occupied by a fresh water lake when the drift first began to be deposited in that region. The facts and considerations are as follows:

1. An extensive deposit of fine sand, containing a few fossil bones, overlain in some places by a lead-colored clay without pebbles, and some fossiliferous silt resembling loess, is found occupying much of the region, especially the lower levels. Ten localities were mentioned where these formations have been observed, the more notable being at Fairview, Dak., Mills Co., Iowa, and Lancaster Co., Neb. A large fossil claw of some gigantic mammal (*Megalonyx*) was shown, which was obtained from Mills Co., Iowa, in the sand below the drift.

2. The occurrence of a stratum of volcanic ashes in such position as to show that wide areas were occupied by still water, just preceding the deposition of the drifts in some parts and during it in others. The localities described and pictured were in Knox Co., Neb., and near West Point, Neb.

3. An objection which may be urged, from the depth of the channel of the Missouri River in this region, is removed by several facts which go to show that said channel has been wholly excavated since the glacial epoch.

(*a*). The rock under the present bed is unglaciated and unoccupied by drift deposits as has been recently demonstrated

by observations made in sinking piers of bridges at Blair and Omaha.

(*b*). The Missouri is still deepening its trough with every flood. This has been determined by soundings at such times.

This fresh water lake, from its time and location, may be quite confidently considered a portion of the great body of water which occupied the western plains during late Tertiary times, and which was named by King, Lake Cheyenne.

GEOLOGICAL NEWS.—GENERAL.—The Rev. B. Baron states his belief, derived from an examination of the flora, that Mada-agascar separated from the African mainland during or even before the early Pliocene. This agrees with the deductions of Wallace. Five-sixths of the plant genera occur elsewhere, but four-fifths of the species are peculiar. The central part of the island is mainly gneiss and other crystalline rocks, with a strip parallel to the main axis of the island, and roughly to that of the crystalline rocks of the continent. The sedimentary strata occur chiefly in the west and south, and comprise eocene, upper cretaceous, neocomian, Oxfordian, lower oolite, and lias. The highest elevations are topped with lava, which is mostly basaltic. There is no active volcano now upon the island.

CAENÖZOIC.—E. T. Newton (Geol. Mag.) describes some recent additions to the preglacial Forest-bed fauna; including *Cervus rectus* n. sp. He refers the bovine remains to *Bison bonasus*, and the phocine to *Phoca barbata*. The narwhal, beluga, and *Phocaena communis* are also added to the list.

Sig. Ristori describes a Scylla found near Verona, but not sufficiently well preserved to warrant the formation of a new species, though it evidently differs from *S. serrata* and *S. michelini*, M. Edwd., and also from *S. hassiaca* Th. Ebert. It is the only example of the genus yet found in the Italian Territory.

Sig. Ristori (Boll. Soc. Geol. ii., vii. 188) describes an Inuus, *I. caudatus*, from the Pliocene of the Valdarno. This species had previously been erected into the type of a new genus by Igino Cocchi.

Oreopithecus bimbolia Gervais, is declared by Sig. Ristori not to be an anthropoid ape, but to appertain to the Cynopithecinae. The example is from the Miocene of Montebamboli.

F. Bussane (Boll. Soc. Geol. ii., vii. 1888) describes a species of Ephippus to which he gives the name of *E. nicolosi*, discovered in the middle Eocene of Val Sordino, near Lonigo (Veronese). It is near *E. longipennis*, Ag., but has denticulated spinous rays in dorsal and anal.

From an examination of fossil plants found near Rome, G. Antonelli concludes that in the plistocene period the neighborhood afforded a good number of land and fresh water species, mostly of a woody nature, and identical with recent plants of the same district, so that the climate must have been much the same as now.

The Bolletine of the Geological Society of Italy, 1888, has an account of the pliocene foraminifera of Ca dë Reggio, by Mario Malogili.

G. Ristori describes some Lower Miocene crustacea of Piedmont, including a new Neptunus (*N. convexus*) and *Mursiopsis pustulosus*, nov gen. et. sp., also *Callianassa canaverii* and fragments of unnamed species. Mursiopsis belongs to the Calappidae, and has points of resemblance to Hepatus, Mursia, Lambrus, and Calappilia. The carapax is convex in front, reëntering at the sides, and straight behind, and is trilobed like Calappilia or Lambrus.

A new species of Clupea, from the Oligocene strata in the Isle of Wight, is described at length by E. T. Newton, in the *Quarterly Journal of the Geological Society*, February, 1889. As he is unable to refer the specimens to any known species, he proposes the name *Clupea vectensis*.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—The palæopicrite[2] of Bottenhorn, Hessen-Nassau, consists essentially of olivine and augite, both of which have yielded interesting alteration products. The olivine, when fresh, is discovered in twins, whose twin-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Brauns: Zeits. d. deutsch. geol. Gesell. xl., p. 455.

ning and composition plane is a clino-dome. Upon alteration it gives rise to the rare mineral webskyite[1] and tremolite. The former is found to be an intermediate product in the passage of olivine into serpentine. Its analysis yielded results which indicate for it a composition corresponding to H_2 (Mg. Ie) $S:o_4 + 2$ Aq, that is a hydrated olivine, with part of its magnesium replaced by hydrogen. Its specific gravity is 1.745. The augite of the rock is brown in color, and, like the olivine, gives rise to a peculiar alteration product. This is a green garnet with the composition:

S:	Fe_2O_3	Al_2O_3	Ca O	Sp. Gr.
34.95	30.12	1.77	33.29	3.977

With it is associated helminth. Pseudomorphs of serpentine after magnetite are described in the same rock. A pseudomorph of calcite after chrysotile is mentioned as occurring in chrysotile veins in a diabase from Amelose, and pseudomorphs of the same mineral after the olivine of this diabase are briefly alluded to. An interesting addition to the study of jade and nephrite has been made in the shape of an article by Messrs. F. W. Clarke and G. P. Merrill[2] on the chemical and microscopical characteristics of the materials composing some of the instruments on exhibition in the U. S. National Museum. Analyses, specific gravity determinations, and the study of thin sections of nineteen specimens lead the authors to the view that the jadeite and nephrite objects, which have been gathered from widely scattered localities, cannot be depended upon in the work of tracing the migrations of ancient tribes of people, since (1), the material of which the objects consist is by no means always a pure jade or nephrite, and (2), these substances themselves, when obtained from different sources possess very different characteristics. The analyses and microscopical studies yield little new in regard to the structure of true jade. The paper is of importance as affording proof of the existence of a true jade in Alaska, and as a record of the results of the examination of many jade instruments not heretofore described.

Near the village of Trevalga[3] is a shell of eruptive rock, from seventy to a hundred feet thick, interstratified with slates. Foliation is highly developed throughout its mass in a direction parallel to the cleavage of the slates. In places it is

[1] Cf. AMERICAN NATURALIST, November 1887, p. 1021.

[2] Proc. U. S. Nat. Museum, xi., 1888, p. 115.

[3] Hutchins: Geol. Magazine, Mch. 1889, p. 101.

coarsely laminated, a soft chloritic or micaceous material, alternating with layers of a hard, compact, non-foliated stony substance. The hard layers consist of calcite and feldspar in a mosaic of feldspar, chlorite, calcite, muscovite, secondary quartz, epidote, biotite, and iron compounds. The softer strata contain a great deal of chlorite and epidote is present, the other constituents remaining the same. The epidote is thought to have originated before the development of schistisity in the rock. Both layers have practically the same composition, and are therefore regarded as parts of the same magma. Both show evidences of the result of pressure in the case of their individual components. Only in certain portions, however, (in the softer layers) has this pressure produced foliation.—Ascension Island in the South Atlantic Ocean is entirely of volcanic origin. Its rocks embrace principally trachytes and andesites. The most widespread and the oldest of these, according to Renard,[1] is a pyroxene trachyte with a glassy base, which is locally so largely developed as to yield a trachyte-obsidian. In both phases little microlites of orthoclase are twinned according to the Carlsbad law, showing interpenetrative crosses in the thin section. By the assumption of hornblende the rock passes into a hornblende-trachyte, and by the local accumulation of silica a transition into rhyolite is noticed. The surface of the island is covered with scoriaceous basalts. In some localities an andesite occurs in which the augite is bronzite. Over several circumscribed areas the volcanic rocks contain, as inclusions, fragments of granite, diabase, and gabbro.—A few notes on the rocks occuring in the auriferous tracts of Mysore Province, South India, are communicated by Burney[2] as an appendix to an article by Attwood on the structure of the region. The rocks embrace eclogites, hornblende, and mica schists, all showing evidence of the effects of great pressure and also dykes of various eruptive rocks. The gold is found in quartz veins in the schists.—An interesting trachyte[3] from the Cumana railroad tunnel, near Naples, Italy, contains sanidine, two varieties of hornblende, and rod-like aggregates of hornblende and pyroxene in a ground mass of sanidine, amphibole, and magnetite. In the vesicles of the rock are large, colorless pseudo-hexagonal crystals of sodalite, rods of black amphibole, pyroxene, little crystals of sanidine,

[1] Bull. Mus. Roy. d. Belg. T. v., No. 1, p. 5.

[2] Quart. Jour. Geol. Soc., Aug. 1888, p. 636.

[3] Johnston-Lavis: Geol. Magazine, Feb. 1889, p. 74.

and tufts of a fibrous titanium mineral.—The alteration of an epidiorite into a chlorite schist is described by Hutchings[1] from Tintagel N. Corniwall. The epidiorte contains, in addition to the usual constituents of this rock, grains of colorless epidote, a little calcite, a very little quartz and some secondary feldspar. As schistosity is induced the amount of calcite, chlorite, and quartz increases, and epidote disappears, until finally a typical chlorite schist results.—Brief descriptions of the rocks of Somali Land, in Northeastern Africa, and of the island of Socotra are given by Miss C. A. Raisin[2] in recent numbers of the *Geological Magazine*. Those of the former locality are granites, hornblende, diabases, porphyrites, gneisses, and talc and epidote schists, overlain by limestones and other sedimentary rocks. On Socotra is a felsite with corroded quartz crystals, in which the included groundmass forms concentric rings separated by quartz material.—Ternier[3] describes very greatly corroded quartz crystals in a micro-granilite from Osaka, Japan. These crystals are surrounded by little islands of quartz with the same optical orientation as the larger grains, and the entire group is enclosed in a zone, composed of fibres of quartz and orthoclase, of which the former extinguish parallel to the large quartz crystal.—Wyronboff[4] has analyzed a specimen of the black, opaque, friable obsidian, with a fatty lustre, that occurs at Obock, and obtained the following result:

$S:O_2$	A_2O_3	Fe_2O_3	MgO	V_2O	H_2O	Sp. Gr.
70.00	13.88	2.77	1.20	7.78	4.11	2.345

MISCELLANEOUS.—*Etched figures.*—It is well known that the character of the figures produced by etching a crystal of quartz with hydrofluoric acid varies with the nature of the crystal, and also with the symmetry of the face acted upon. With a knowledge of these facts, Messrs. Otto Meyer and Penfield have subjected a sphere of quartz to the influence of strong hydrofluoric acid, and have presented their results in a beautifully illustrated article. The difference in the case with which the acid etches various portions of a crystal of quartz is finely brought out by the shape which the sphere assumes

[1] Geol. Magazine, Feb. 1889, p. 53.
[2] Geol. Magazine, 1888, p. 414 and p. 504.
[3] Bull. Soc. Franç. de Min., xii., p. 10.
[4] Bull. Soc. Franç. d. Min. xii., p. 31.
[5] Trans. Connecticut Acad., viii., 1889, p. 158.

after prolonged action of the etching agent. It is found that the acid acts very unequally on different parts of the sphere, corresponding to the different crystallographic faces of the crystal from which it was cut, but equally with reference to the system of hexagonal axes. In this way the tetartohedral symmetry of the mineral is strikingly revealed. The action is greatest at the two extremities of the vertical axes, while at the ends of the lateral axes it seems to be almost nil. As a final result of the action of the etching agent the sphere is reduced to a lenticular body with a triangular cross section, with the three angles of the triangle at extremities of the lateral axes.—A comparison of the shapes and positions of the etched figures produced on halite and sylvite upon their exposure to moist air has been made by Brauns.[1] Those in rock salt are usually bounded by the planes of a tetratis hexahedron, which may vary in formula between ∞ O [illegible] and ∞ O $\frac{11}{[illegible]}$. Occasionally a depression bounded by the planes [illegible] O is [illegible] observed. In both cases the position of the figures on the faces etched are such that they possess the same planes of symmetry as does the face upon which they are. On sylvite, on the other hand, the depressions have no planes of symmetry in common with those of the crystal face. Halite is therefore regarded as holohedral, while sylvite is gyroidally hemihedral. The same writer mentions the existence of twinning strialtuis on cleavage pieces of rock salt, whose twinning plane is 2O O.

New Books and Pamphlets.—"Les Mineraux des Roches"[2] is the first French book that treats of optical properties of minerals in a way to be of use to students in the study of thin sections of rocks. As the authors state in their preface, the new book is a natural complement to Fouqué and Lévy's "Mineralogie Micrographique." In the first part the author (Lévy) discusses the application of the principles of optical mineralogy to the study of minerals in thin sections of rocks. The methods made use of in this discussion are somewhat new to petrography, as they are based more upon mathematical considerations than is usual. The fundaments of crystallography and of optical mineralogy are presupposed, as is also a knowledge of spherical geometry and trigonometry. After deducing the mathematical relations of the optical axes and bisectrices, the curves of extinction in the principal zones

[1] Neues Jahrb. fur Min., etc., 1889, i., p. 114.

[2] "Les Mineraux des Roches," par Michel Lévy et Alf. Lacroix. Paris, 1888. Baudry et Cie. 218 fig., 1 pl., pp.

of monoclinic and triclinic minerals are constructed, in the manner familiar to the readers of the "Mineralogie Micrographique." The development of the laws of double refraction and pleochroism, etc., follow, and the facts thus developed are graphically illustrated by diagrams. A special feature of this portion of the book is a large, lithographic plate, by means of which the nature of the substance composing a crystalline particle of known thickness may be determined by noticing its color between crossed nicols. The general portion of the book concludes with an excellent chapter on microchemical reactions.

In the special portion, (by Lacroix), the chemical, morphological, and physical properties of a large number of minerals are given in concentrated forms. The appearance which these minerals present in the thin section, and their general characteristics, however, are not described, so that the book is in reality a text-book in optical mineralogy. The features which have made Professor Rosenbusch's "Mikroskopische Physiographie" so invaluable as a guide to the detective minerals *in rocks* are lacking in the volume before us, but many of those in which the latter is wanting are found in the former in good quality. "Les Mineraux des Roches" is really a complement to Rosenbusch's work, supplementing it in those very portions where the "Mikroskopische Physiographie" is weak. It is unnecessary to remark that the book of Lévy and Lacroix is one to be placed in the hands of a beginner in the study of optical mineralogy, although it will prove of inestimable value to him who is already familiar with the general principles of the science.—Mr. Eyerman[1] has collected in a pamphlet of fifty-four pages descriptions and notices of the new minerals and new mineral occurrences that have been discovered in Pennsylvania during the fourteen years since the appearance of Dr. Genth's "Preliminary Report on the Mineralogy of Pennsylvania." The analyses of Pennsylvania minerals that have been published during this period are reproduced, and a few original observations of new occurrences are given. Authorities are quoted in all cases, so that the pamphlet is of great value to anyone interested in the minerals of Pennsylvania.—The "Catalogue of a Collection of Precious and Ornamental Stones of North America, Exhibited at the Paris Exposition, 1889, by Tiffany and Co.,[2]" contains a very complete list of

[1] "The Mineralogy of Pennsylvania." Part i., Eastern Pa.

[2] New York. The De Vinne Press. 32 pp.

the valuable minerals and gem materials of North America, numbering, in all, three hundred and fifty-two specimens.

BOTANY.[1]

As Regards Some Botanical Latin.—Scientific Latin is often said to be the laughing-stock of philologists. This may not concern botanists very much, as they do not require anything but scientific usefulness of their Latin. Nevertheless, if they are to use Latin, it is best that they use good Latin, especially as that is not a matter of very great difficulty. A principal source of inaccuracy in botanical Latin is the fact that a large number of names had their origin in the last century, or even earlier, when impure, medieval Latin was dominant. Then modern botanists, in attempting to give these names classical forms, often make them still worse. Besides, scientific men are not always as good philologists as they should be, so that many modern names are faulty.

Whether medieval Latin should be retained in Botany, on account of its antiquity and long use, or the purer forms should be substituted, is no part of the present consideration. But I may say in passing that the Latin studied and written for the most part to-day is classical Latin, and for this reason attempts to retain eighteenth century forms are liable to result in inaccuracy and absurdity.

Some of the principal characteristics of eighteenth century Latin are the use of ch for c and y for i in many words, in imitation of the Greek, and the use of the feminine nominative form for the masculine in adjectives like campester and paluster. On the continent Pirus has largely replaced Pyrus for some time, and this spelling has been followed to some extent in this country. English authors retain the eighteenth century spelling. But as is usually the case in changes of this kind, authors are inconsistent, changing some forms, and retaining others capriciously.

Of German authors, Luerssen writes Pirus, Pirola, silvester, etc. Frank (in Leunis, Syn. der drei Naturreiche) uses classical forms throughout. Drude (in Encyklopaed. der Naturwissenschaft.) writes Pirus, but sylvestris. Koch (Dendrologie) does the same. Sachs seems to prefer classical forms, but

[1] This department is edited by Professor Charles E. Bessey, Lincoln, Neb.

uses both. Winter uses eighteenth century forms as a rule, but his lacrymans is a hybrid.

Saccardo (Syl. Fung.) uses classical forms as a rule, but, probably from carelessness, is very inconsistent. He writes Piri, Pirolæ, campester, paluster, silvester. But sylvatica and sylvana! He has sometimes lacrymans, and sometimes lacrimans.

French authors usually prefer Pirus—but sylvestris and sylvatica. Vesque, however, has Pyrus.

Of American authors, Gray always consistently uses eighteenth century forms. Watson (Index and Botany of Cal.) writes Pirus; but sylvestris and sylvatica, and, curiously enough, the diminutive Pyrola. Coulter uses eighteenth century forms as a rule, but has the hybrid sylvester. Britton uses eighteenth century forms consistently.

It will be noticed that those who retain the eighteenth century Latin do so consistently, while those who attempt to substitute classical forms do it capriciously and without system. There seems no good reason for this, and it is probably largely due to carelessness. At any rate, if Pyrus is to be spelled with an i, so should sylvaticus, sylvanus, and sylvestris, and the latter should have the termination ter. If eighteenth century forms are to be retained we should write lachrymans; otherwise lacrimans. We cannot split the difference in this matter.—*Roscoe Pound.*

THE PRONUNCIATION OF SCIENTIFIC NAMES.—The following are the rules for the pronunciation of scientific names, adopted by the Botanical Seminary of the University of Nebraska.

I. In general, all names of the branches, classses, orders, and families of the vegetable kingdom, and their subdivisions, and the names of all genera and species shall be pronounced according to the "Roman Method."

II. Generic and specific names derived from un-Latinized personal names may, if difficult to pronounce as Latin, be pronounced according to the rules of the language from which they are derived. But even in these cases the Roman pronunciation is recommended if it can be used.

III. Latin words which have become Anglicized shall be pronounced as English.

IV. The following is a conspectus of the Roman Method:

1. Vowels.
   A, long as in German; short as in ideă.
   E, long as in German; short as in English (ănd).
   I, long as in German; short as in English (it).
   O, long as in English; short as in obey.
   U, long as in boot; short as oo in foot.
   Y, as I.

2. Diphthongs.
   Ae (ai) as long i in English,
   Au as ow in now.
   Eu as ew in few.
   Oe (oi) as oy in English.
   Ou (ow) as long u (Roman).
   Ui as we in English.
   Ei as in eight.

3. Consonants.
   C and G *always hard.*
   S always sharp; never like z.
   J like English y.
   U like English w.
   Bs like ps.
   Ch like k.
   Th always as in thin; never as in then.
   Others as in English.

4. Quantity and Accent.
   (1) A vowel before another vowel or *h* is short.
   (2) A diphthong is long.
   (3) A syllable in which a vowel is followed by two consonants or a double consonant is long. Before nf, ns, gn, or gm the vowel itself is long.
   (4) A syllable in which a short vowel is followed by a mute with *l* or *r* is common.
   (5) Words of *two* syllables are always accented on the *first.*
   (6) Words of *more than two* are accented on the *penult* if it is *long;* if it is *short* or *common*, on the *antepenult.*

5. Syllables, etc.
   (1) Each vowel or diphthong constitutes a syllable.
   (2) Every syllable should be pronounced.
   (3) When a consonant is doubled or two come together, each should be pronounced.

The "Roman Pronunciation" in Horticulture.—Since the foregoing paper was received, the final volume of "Nicholson's Illustrated Dictionary of Gardening" has come to hand, and in it we notice with pleasure the article on the pronunciation of ordinal, generic, and specific names, by Percy W. Miles of the University of Dublin. After remarking upon the "chaotic state" of the pronunciation of the scientific names of plants, the writer observes that "the way in which many gardeners make havoc with the names of plants has been a frequent subject of satire with philologists and other writers." And again "the manner in which Latin has been, until lately, pronounced in this country is thoroughly inaccurate and unscientific, and so entirely insular that in speech it is often quite

unintelligible to foreigners, even to those who are good Latin scholars. As one of the chief advantages of the uniform Latin nomenclature of plants is that thus a sort of universal or international language is created, it is evident how much has been lost by our predjudiced adherence to a provincial mode of pronunciation."

After much consideration and consultation with several eminent botanists, the writer determined to follow the Roman system of pronunciation in his article. He proceeds to give the essentials as to accentuation, quantity, and the pronunciation of particular letters, practically as given in the rules set forth above.

"It will be as well to guard the reader against the supposition that there exists at present for botanical names any recognized standard of pronunciation from which he may imagine that this dictionary often presumes to depart. The fact is that there is no such established standard. In many cases the common text-books are utterly at variance, and the usage, not only of good gardeners, but of educated botanists is often hopelessly divergent."

In but one point of importance, (and that is in fact of but minor importance,) are the rules different from those printed above. Mr. Miles says that *in all cases* of words commemorative of the names of men, we should pronounce the word "as nearly as possible in the way in which the name to be commemorated was sounded." Thus he would have us say *Stokes-i-a*, not *Sto-ke-si-a*, *Men-zies-i-i*, not *Men-zi-es-i-i*. We are of the opinion that the rule of the Seminar, given above, is preferable, and will in the end lead to the best results.—*Charles E. Bessey*.

ZOOLOGY.

SOME CASES OF SOLID-HOOFED HOGS AND TWO-TOED HORSES.—In 1878 "soliped" pigs were reported from Texas. Dr. Coues observed that in the new breed the terminal phalanges of the toes were united, to form a single broad phalange; above this, however, the other two phalanges remained perfectly distinct. The hoof is perfectly solid, and on its sole there was a broad, angular elevation of horny substance, curiously like the frog of the horse's hoof. The breed was so firmly established that no tendency to revert to the original and normal form was then observable. It was further stated

that, in the cross of a solid-hoofed boar with a sow of the ordinary type, a majority of the litter has the peculiarity of the sire apparent.

There has just been reported to me from Sioux City, Iowa, (famous for its annual "corn palace") a similar case. Indeed, it would seem as if the owner was quite alive to their rarity and had been breeding them for some time, and had now as many as induced him to advertise them for sale, "not alone for being a curiosity, *but in a commercial sense a valuable production for mankind!*" The owner continues: "The experience of the writer convinces him that there is no better hog for the healthy growth of pork. These hogs are of long body, and have well proportioned hams and shoulders. It is true they have not the fine head of the 'improved' breeds... In size they are fair, a couple of barrows (accidently castrated) now near thirteen months old, without special care weigh over 350 pounds each. As yet there has been no sign of any loss from disease whatever (though diseases have been common in that district for years). A few boars, six to eight weeks old, will be sold...." etc.

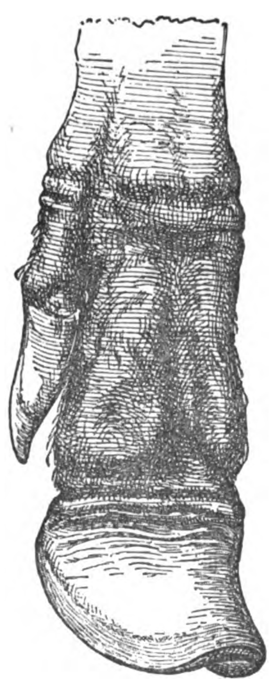

Fig. 1. Solid-hoofed Hog.

We are making further inquiries into the above, and will report results.

But it seems quite evident that these "mule-footed" hogs are of frequent occurrence in America. Some "get into print," and some don't. For instance we are obliged to the *Rural New Yorker* for two more cases. A known correspondent to that excellent periodical writes thus, from Cottonville, Louisiana, in the issue for September 22d: "As a curiosity which I never saw before, or even heard of, I send the foot of a 'mule-footed' hog. There is a herd of them ranging the woods, about eight miles north of Baton Rouge. None of the old settlers can give me any further information concerning them than "that they are a herd of wild hogs.'" An exact drawing is published with the above, which is enclosed for your reproduction. (Fig. 1.) The editor adds a note to

the above : "We have seen several of these 'mule-footed' hogs. In a small Southern town, a large Poland-China boar had one hind foot exactly like the one shown in our picture, and a large proportion of the young pigs from him were marked in the same way."

We have also had undoubted cases of extra-toed horses reported here. During the summer of 1885, *The Advertiser*, Constantine, this State, contained the following : "On Wednesday night of last week a mare belonging to Mr. Fred Hagenbuch, of Fabius, gave birth to a male colt, well formed and perfectly symmetrical in all respects, except that one of the feet is cloven and hoofed like the foot of a cow. Who has a mate for this colt ?" This was quoted in *Breeder's Gazette*, Chicago, the leading breeder's paper of America, and brought out a response from Mr. N. C. Woolf, in issue for July 16th, thus : "My neighbor, Mr. D. M. Hall, has a two-year-old colt that exactly fills the above description. For a few months Mr. Hall has taken great pains in shoeing, and thinks he will succeed in making a pretty good hoof."

These cases are, I think, of sufficient interest to entitle them to be rescued from the oblivion that they must experience. And they are, I think, of sufficient value to have a place accorded them in THE NATURALIST.—*R. C. Auld*, Pinckney, Michigan, U. S. A.

INTERESTING CASES OF COLOR VARIATION.—As a contribution to the increased interest attaching to the recent discussions of color variation in animals, as bearing upon the problems of natural selection, the following may not be without value. The first is that of some remarkable variations in color in the common robin, Merula migratoria. Some two years ago, in the Spring of 1887, while studying the habits of this bird, strolling almost daily into their haunts, I was much struck by what at first appeared a strange bird among a group of robins. A moment's attention, however, disclosed the true character of the stranger, and showed it to be strange only in the matter of color, which was a motley of white and gray on the head, neck, shoulders and back. Though having no means of securing the specimen at the time, an attentive study of the marking showed that it could not be a case of albinism, as is so often the case in such variations. The bird was not seen for that time only, but I saw the same specimen a few days later, and then repeatedly during the Spring, as it proved to be a female, and nested near my home. No propagation of the variation appeared in the offspring that was appreciable.

The following Spring I noted evidently the same bird in the same locality, and at about the same time in the season. It remained in the neighborhood during the Summer, again nesting. In neither season did there appear any signs of transmission of the peculiarity to the offspring.

A robin similarly marked was noted by Mr. Amos. W. Butler, and reported by him through the Journal of the Cincinnati Society of Natural History. Altogether, the cases seem rather anomalous and outside the usual causes involved in such variation.

Another case of similar character came under my observation later. In the Spring of 1888 I captured two *moles*, *Scalops aquaticus* (?) on my lawn, both of which had markings of pure white on the neck and belly. In another specimen, only the skin of which I saw, but which was taken in the neighborhood, the white extended on one side to the back in irregular blotches, giving to the skin a strangely variegated appearance. As is well known, the color of this mammal is quite constant, and of a dark plumbeous or slaty hue, slightly lighter below. I have seen no record of a tendency to vary in the manner noted above, or indeed in any way in particular. The usual color is, of course, quite in keeping with its habits and environment, and in so far might be assumed as the result of natural selection. But how are we to account for these peculiar variations? Are they the expression of a tendency to revert to a primitive or to an ancestral type, or are they not rather in keeping with what is so often seen in plants as well as in animals under changed conditions, due to causes obscure in their nature and as yet very imperfectly understood? The recent discussions of these matters by Agassiz, Riley, and others, and the reference of Mr. Adam Sedgwick in a recent number of *Nature*, to the remarkable coloration in Peripatus, when its habits are taken into account, seem to lend great plausibility to the principle of "Saltation," or sudden and obscure variation.

Altogether, there seems reason for moderation in reference to *any theory* as yet proposed. Evidently, the evidence is not yet all in.—*C. W. Hargitt*, Miami University, Mar. 25, 1889.

THE BALD CHIMPANZEE.—Dr. P. L. Sclater describes in *Nature* (1889, p. 254), a couple of female apes from tropical West Africa, which resemble the chimpanzee, and yet differ in marked features. The ear is much larger, and the hair is generally sparse, so much so on the head as to permit the application of the term bald. The color of the face is blackish. In

the chimpanzee the head is thickly clothed with hair, the face is flesh-colored, and the ears are smaller. Both these animals (which are in the London Zoological Garden) are carnivorous, catching and eating sparrows and pigeons. It is stated that this is never done by the chimpanzee. Dr. Sclater provisionally refers these animals to the *Anthropopithecus calvus* of Du Chaillu.

ZOOLOGICAL NEWS.—CŒLENTERATA.—Dr. H. V. Wilson records (*J. H. U. Circ.*, No. 70) that in *Cereactis bahamensis* the mouth occasionally grows together in the middle, leaving oval and anal openings at the ends. He also found a single larva of *Manicina areolata*, which exhibited the same peculiarity. In this connection reference is made to Sedgwick's celebrated paper on Metameric Segmentation.

In the same place Prof. J. P. McMurrich gives a list of the Actinaria of New Providence, enumerating fourteen species, of which *Cereactis bahamensis*, *Bunodes tæniatus*, *Aulactinia stelloides*, and *Gemmaria isolata* are new. The fact is also recorded that *Aulactinia stelloides* passes through an Edwardsia stage when eight nusenteries are present and the longitudinal muscles are arranged as in that genus.

ENTOMOLOGY.[1]

OBSERVATIONS ON ANTS, BEES, AND WASPS.[2]—Sir John Lubbock has published the eleventh part of his observations. He is of opinion that, though there may be nests of *Formica sanguinea* without slaves, an experiment which he has made seems to indicate that the slaves perform some important functions in the economy of the nest, though it is not yet determined what that function exactly is.

With regard to Ant-guests, he points out that Dr. Wasman has confirmed his observations, in opposition to Lespès, that, while ants are deadly enemies to those of other nests, even of the same species, the domestic animals may be transferred from one nest to another, and are not attacked. Attention is next drawn to Professor Emery's observations on mimicry among ants.

With regard to the color sense, Professor Graber has confirmed Sir John's observations on Ants and Daphnias, by

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Journ. Linn. Soc. Lond., xx., (1888) pp. 118-36. 1889.

which he showed that they are sensitive to the ultra-violet rays, by similar observations on earth-worms, newts, etc. Light was found to act on decapitated earth-worms, though the differences were not so marked; the same held good for newts, when their eyes were covered over, and Graber hence concludes that the general surface of the skin is sensitive to light. Forel has made some observations on ants, the eyes of which were carefully covered by opaque varnish, so that they were rendered temporarily blind.

From experiments made with Platyarthrus, which have no eyes, the author found that they made their way into the shaded portion of a partly covered nest, and he remarks that it is "easy to imagine that in unpigmented animals, whose skins are more or less semitransparent, the light might act directly on the nervous system, even though it could not produce anything which could be called vision."

Sir John's experiments lead him to differ from M. Forel, who believes that bees have a certain sense of direction. The power of recognizing friends is discussed at some length, but the explanation of the fact still remains obscure. The most aged insect on record is a queen of *Formica fusca*, which lived for fifteen years; what is much more extraordinary is that she continued to lay fertile eggs; fertilization took place in 1874, at the latest, and there has been no male in the nest since then, so that the spermatozoa of 1874 must have retained their life and energy for thirteen years.

The seeds of *Melampyrum pratense* are, as Lündstrom has recently pointed out, closely similar to the pupæ of ants, and he has suggested that this may be an advantage to the plant by deceiving the ants, and thus inducing them to carry off and so disseminate the seeds. The author's own observations show that *Formica fusca* appears to take no notice of these seeds, but that, under certain circumstances, they are carried off by *Lasius niger*.

The observations of Mr. and Mrs. Peckham, on the special senses of Wasps, is referred to as containing conclusions which concur closely with those of Sir J. Lubbock.

A connected account of the author's observations is given in a recent work, "On the Senses, Instincts, and Intelligence of Animals, with Special Reference to Insects,"[1] which will be found useful as a handbook of the subject with which it deals. —*Jour. Royal Micr. Soc.*, 1889, p. 49.

BASAL SPOT ON PALPS OF BUTTERFLIES.[2]—Herr. E. Reuter states that in all the species of butterflies (between two

[1] 8vo, London 1888, 292 pp., 118 Figs.

[2] Zool. Anzeig. xi., (1888) pp. 500-3.

and three hundred) which he has examined there is at the base of the inner surface of the palps a naked spot which can be always easily seen. He consequently regards it as typical of the order.

It is generally well defined and ordinarily occupies the basal half of the first joint of the palp. The rings or furrows discovered by Landois are always present, though often indistinct or incomplete. When present, they ordinarily occupy the greater part of the basal spot, and are more or less parallel. They are best developed on the part of the surface which, in the natural position of the palps, is directed upwards and inwards; it is this part which is most commonly pressed against the basal part of the proboscis, which is provided with a raised ridge.

In addition to these rings there are peculiar forms of hairs which do not seem to have ever yet been described. They are conical in form, chitinous, are surrounded at their base by a circular membrane; they are all connected with nerve-fibers, on which, just before they enter the cone, a ganglionic swelling can be seen. There are several hundreds of these cones, and, in addition to them, there are immense numbers of similar, but much smaller, conical bodies. In the Micro-lepidoptera there are sometimes also pits or pores, and sometimes these are alone present.

There can be no doubt that we have here to do with specific sensory organs, but what is the special sense we do not know. The author is inclined to think that it is of an olfactory nature. The cones exhibit the greatest variability and highest grade of development in the Rhopalocera, and their variations may be of use in the definition of families and genera. In the Butterflies proper, the organ in question is always much larger and better developed in the male than in the female.—*Jour. Royal Micr. Soc.*, 1888, p. 943.

PARASITE OF COSMOPOLITAN INSECTS.—Under the title of "A Commencement of the Study of the Parasites of Cosmopolitan Insects,"[1] Mr. L. O. Howard gives a list of nearly 100 insects, common to the Old World and the New, together with a list of the European parasites of each, and a second list of the American parasites of each. This paper presents us with a large amount of information in a very compact space, and we hope it is only a forerunner of a more extended paper by the same careful author.

As illustrating the practical use that can be made of infor-

[1] Proc. of the Ent. Soc. of Washington, Vol. i., pp. 118-36.

mation of this kind, Mr. Howard gives the following interesting illustration:

"The Hessian Fly has been very destructive for two years past in England, and the question has been, and it is an important one, whence did it come? Two important wheat-growing districts furnish England with much of its grain, *viz.*, North America and Russia. Now it happens that within a few months of each other Dr. Riley monographed the North American parasites of this insect, and Dr. Lindemann the Russian parasites. No accurate way of fixing the source of the English supply was found, until Dr. Riley, on his recent trip to England, discovered that the parasites there were identical with the Russian forms, and, with one exception, specifically distinct from the American forms; the exception belonging to the Russian fauna as well as to the American. America is thus relieved from the onus, which falls on Russian shoulders."

THE EPIPASCHIINAE OF NORTH AMERICA.—Under this title the Rev. Geo. D. Hulst[1] monographs the American representations of that small group of moths of which Epipasachia is the typical genus. As to the zoological position of this group, he looks upon the Epipaschiinae as either connecting the Phycitidae with the Pyralidinae, or as the ancestral and now nearly obsolete stem from which, in different directions, the other two have arisen. He enumerates eleven genera, represented by nineteen species.

A STUDY OF THE CYNIPIDAE.—There is on our table a valuable paper on this subject, from the Agricultural College of Michigan, by C. P. Gillette. The paper is based on collections made in the vicinity of Lansing. Mr. Gillette makes many observations on the previously described species, and gives descriptions, with figures, of the galls of several new ones. A list of thirty-four species of Galls Flies, taken in this locality, and of the parasites bred from them, is appended to the paper.

COLEOPTEROUS LARVÆ AND THEIR RELATIONS TO ADULTS.—The present paper is the first of a series of investigations which it is my purpose to carry on in connection with the larvæ and their relations to adults. My studies are confined to the post ovarian stages, and in this discussion the term larvæ is used to indicate such conditions only. It is my purpose to inquire into the origin of larval forms, both ancestral and acquired, and to compare the results of the study of

[1] Entomologica Americana, Vol. v., pp. 41-52, 61-76.

the larvæ of the various groups of the animal kingdom with the results of the study of adults. The following questions are among those for which an answer is sought:

To what extent are larval forms representatives of ancestral stages in the history of animals, and to what extent are they adaptations on the part of the larvæ, and therefore secondary?

How far is it possible to assign reasons for the larval departures from ancestral type?

Has the larval departure from an ancestral type, where it has taken place, occurred in numerous individuals simultaneously, or have the variations appeared in one individual and then been transmitted from it to a long line of posterity.

Have the forms and habits of the adult any direct influence on the larvæ, or those of the larvæ on the adult?

Are larvæ reliable as a basis of classification.

Are larvæ of any value in teaching the past history of animals?

Are larvæ of any value in teaching relations?

In cases where larvæ are departures from the ancestral type, and therefore secondary, are they of any value in teaching past history or present classifications?

Are larvæ more or less variable than adults?

Are adaptive larval characters inherited by succeeding larvæ?

The present paper is the result of the study of the larvæ of beetles, this group being first selected as showing the greatest amount of variation within a single order. As a starting point a Campodeoid form is taken. This is the most widely distributed, and has frequently been pointed out as the closest representative of the ancestral insect living at the present day. Starting with the Campodeoid type the different families of beetles have been studied as far as is possible with our present knowledge of them. The following are the most important points presented by the study of this group.

1. With the exception of the Campodeoid type of larvæ, which is found in a number of families, all beetle larvæ are secondary modifications which have been introduced during the larval life of the beetles, and have never been represented by any adult features. They are, therefore, of no value in teaching the history of beetles except in their larval stages. They do not represent ancestral stages. They may, however, and frequently do, teach relationship, since the presence of a similar larva may indicate a recent common ancestor.

2. It is possible, amid the immense variety of larvæ, to rec-

ognize four somewhat distinct types: the Campodeoid type, a type slightly and variously modified from the Campodeoid type, a Scarabid type, and a maggot-like type, like that of the weevils. In many cases it is possible to determine definitely the sort of conditions that have produced the present type.

3. The division of larvæ into types seems to have no relation to the classification of adult insects into sub-orders. None of the classifications of adult beetles into sub-orders runs in any way parallel to the natural division of larvæ into groups. The classification of the families of larvæ does, however, run parallel to the classification of the families of adults, so that it is usually possible to tell from the structure of a larva to what family it belongs. To this rule there are many exceptions, some of which are easily explained by differences in habit. The exceptions are most common in the low, degraded types of larvæ. The classification of families into sub-families and genera seems also as a rule to run parallel with the classification of adults, though there are many exceptions to this rule. The exceptions are such as to indicate that in some cases the adult classifications are at fault, and in other cases that there is really no parallel between the two stages. From this we can draw the conclusion that the present larval types of beetles are about as old as families but not much older.

4. The amount of departure from the primitive larval type that any family of beetles presents, is no indication of the position in the scale of classification that the adults should occupy. At least this is true if we accept the classsification of adults recognized at present by our entomologists.

5. Family characteristics are usually well marked in the larvæ. Generic characteristics are also usually quite definite; specific differences are usually very small and do not seem to be very constant.

6. There is in most cases an evident relation between the habits of the larvæ of a family and those of the adults. This indicates that the habits acquired by one stage have subsequently had their effect on the habits of the other stage. It seems probable that in beetles the larvæ has been the first to modify its habits, and that the adult has subsequently acquired habits related to it. The larval stage seems thus to be more important than the adult; at all events it is more thoroughly protected, and is the first to be adapted to suit its surroundings.

7. The larvæ of beetles are much more diversified than their adults.

8. Although habits and the conditions that surround the larvæ have been very important features in the production of the present larval forms, some other force has been at work in producing, or rather in retaining them. For we find a great variety of larvæ at the present time with almost identical habits. This other force is undoubtedly heredity, which has frequently proved stronger than the modifying effect of the environment.

9. Beetle larvæ cannot be classified by the same characteristics used in classifying adults. The shape of the antennæ has no significance in the classification of larvæ, since it is almost uniform throughout the order. The shape of the legs, the number of tarsi, the shape of the coxal cavities, are of not much more value. The mouth parts seem to be of a little more value, and are of far less value in classification than they are in the adults.

10. The mouth parts of beetle larvæ, even in the typical Campodeoid form, are not Campodeoid in type, but approximate rather closely to those of the adult beetles. No traceable similarity can be found between the mouth parts of any particular family of larvæ and those of the adults of the same family, beyond the general similarity sometimes produced by like habits. It is true, however, that the mouth parts of all beetle larvæ are more like those of adult beetles than they are like those of any other order of insects. This is probably an example of what Hyatt and Cope call concentration of development, and which is elsewhere called precocious inheritance. It is an instance where the characters of the adult have been impressed on the larval stages.

11. In beetle larvæ we have quite a number of cases in which a similar larval type has been acquired independently in two or more families.

The above conclusions apply only to the group of Coleoptera, and while some of them will doubtless be found equally true of other orders of insects, some of them are probably peculiar to beetles.

This paper was discussed by Professors Hyatt, Putnam, and Fernald, and by Messrs. Sargent and Jackson.—*H. W. Conn, in Proceedings of Boston Society of Natural History*, Vol. xxiv., December, 1888.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island, Nov. 10, 1888.—This being the annual meeting, officers for the ensuing year were elected as follows: President, L. P. Grata-

cap; Treasurer, Samuel Henshaw; Recording Secretary, K. B. Newel; Corresponding Secretary, Arthur Hollick; Curator, W. T. Davis.

December 8, 1888.—Mr. L. P. Gratacap read the following paper upon the "Relation Between the Growth and Form of Leaves:"

It is obvious that the form of leaves must be the resultant of rates of growth in various directions. That a simple leaf with a single midrib will assume such a mature form as will express the equilibrium of the growing impulse along two axes, a longitudinal and a lateral one, and that as this ratio varies in favor of the first or the second, the leaf becomes ovate, circular, broadly elliptical, etc., or lanceolate, linear and elongated. And secondarily, in the case of the simple leaf, the point of intersection of the axis will modify the final form. If the lateral axis is developed at an early stage in the elongation of the midrib we have ovate leaves, if at a point half way along its length elliptical, if at the distal extremity obovate. And in leaves of a complex structure, whether palmate, pinnate or numerously veined with woody and rigid vascular fibres, we can resolve the entire form into a group of simple forms, wherein we may study the related rates of development in lamination (formation of parenchyma), and in vasculation (formation of ribs, veins, etc.). In other words, the rapid movement forward of rib cells would appear to interfere with or prevent the making of the leaf lamina, and their slow movement to assist it. In a leaf with several ribs the slow progress of the rib-making permits the coalescence of the marginal tissues, and forms polygonal and crenate circular leaves, and also tends to introduce bifurcation and deliquescence of the original fibre bundles. In one where the extention of the ribs is rapid this coalescence is checked and the leaf is sinuate, lobed, irregular and pinnatified.

It is thus apparent that a determination of the *actual* rate of growth in leaves may throw some light or be useful in assisting speculation as to the origin of leaf forms. And it is also apparent that there might be a condition of things exactly the reverse of our supposition given above, and yet produce the same result. That is, a linear leaf might be a, so to say, slowly made leaf as well as a quickly made leaf, if the movements of its parts maintain a ratio which gives extension in length and not in breadth. And in many cases of turgid and dense tissues in leaves this is probably so.

However the measurement of a number of leaf growths in-

cluding those of Morning-glory, Musk-melon, Water-melon, Maples, Magnolia. Peach, Japanese Quince, Five-finger, etc., made this year on Staten Island, do seem to show that the elongated leaves grow much the more rapidly, that the palmate and pinnate leaves stand next in order, and the circular and traverse leaves last. [A diagram was here presented showing these results, in part, with the rate per day of growth; also the slowly diminishing rate of growth of the leaf as it approached completion.]

Of course a number of considerations occur at once to modify the wholesale use of this conclusion. The relative size of the leaves compared should be similar, the condition or healthfulness of the plants alike, the nature of the plant tissue nearly the same, and the position and aspect of the leaves as regards favorable or unfavorable conditions for growth identical. The subject is suggestive and carefully followed up might lead to interesting results.

Mr. Arthur Hollick showed fossil leaf impressions in ferruginous sandstone, found near Arrochar station by Mr. Gilman S. Stanton. They are undoubtedly from the same formation as those from Tottenville (Cretaceous?) described in the Proceedings of December 8, 1883, and like them, were not in place where found, but occurred in Drift rocks. The specimens are too fragmentary for determination, but the fact of their discovery at this new locality is a matter of interest and is therefore placed upon record.

Specimens of bowlder clay from the same locality were also shown. It has been lately utilized for brick making. There is a fine exposure of modified drift overlaid by bowlder drift where the railroad has been cut through.

Dr. A. L. Carroll noted the discovery on Staten Island recently of *Bothriocephalus latus*—the first reported occurrence of this parasitic worm in America.

Specimens of the "Large Mocker Nut," (*Hicoria alba*, (L.) Britton, *var. maxima*, (Nutt.) Britton.) were presented—being an addition to the local flora. They were collected by Dr. Britton near Court House station.

Adjournment at ten o'clock.

February 9, 1889.—Mr. Charles W. Leng read a paper upon "The Buprestidae of Staten Island," illustrated by specimens of the species mentioned.

It is thought that the larvæ of many species take years to perfect their growth and an instance is recorded of a *Buprestis*

emerging from the wood of a desk that had been in use for 20 years. One of our commonest species, *Chrysobothris femorata* is, however, said by Packard to complete its transformations in twelve months, so the usual period is uncertain.

This insect is found every year in numbers on oaks and occasionally other trees. I took the greatest number about 1880, when Mr. Davis and I found a log near Silver Lake literally alive with them. They would take short flights and lighting on the log, hide in the crevices of its bark, which by their color and deep wrinkled furrows they simulate to a degree. Many other species have this restless habit of flying from place to place, and on the wing, look and buzz very like flies.

Two species of *Agrilus* are also abundant—*ruficollis* and *otiosus*—the first usually on wild blackberries and the second on a variety of young saplings. When the trees around Martling's Pond were cut down about three years ago, a growth of saplings sprang up on which the species of *Agrilus* were quite plentiful, and besides many *otiosus* an occasional *bilineatus* or *interruptus* was found.

I have never found any of our other species in great numbers. Of the *Anthaxia* all my specimens have come from a clump of wild cherry in the Clove Valley. *Chalcophora* is said to breed in pine, but a good deal of beating has yielded little. The species have been found washed upon the beach, and one specimen of *liberta* was taken by Mr. Davis flying at Watchogue. Two species of *Brachys* occur on the leaves of certain oaks, and I have found them in North Carolina in great numbers. Probably they will be found abundantly somewhere on Staten Island.

Chrysobothris azurea was a notable capture of 1886, and is everywhere counted a rare insect, but from May to July of that year it was plentiful on a species of dogwood in a thicket now burned over and turned into "Prohibition Park." The house, built, as I am told, for the dominie, stands just above where the first was taken. The beetles were very quick in their movements, and were captured by beating the trees over an umbrella, out of which they flew again as soon as they touched it. Several were observed resting on the main stems of the young trees, with the anterior legs extended, and the last ventral segment touching the bark, and they were probably females depositing their eggs. None have been found since 1886, nor have I been able to find the larvæ in the few trees that are left.

SCIENTIFIC NEWS.

The Trustees and Director of the Marine Biological Laboratory are now forming a permanent and somewhat extensive library for the use of workers at Wood's Hall. They have received already a gift of money sufficient to secure a very considerable nucleus of sets of biological journals and other standard works, to which they now desire to add also monographs and special contributions. As members of the Committee on the Library, we venture to ask that you will send to Dr. C. S. Minot, Harvard Medical School, Boston, Mass., any copies of your own publications, as well as any duplicates or other books, etc., which can be spared from your own collection of biological works, and which you are willing to present to the Laboratory. All works received will be promptly acknowledged and duly catalogued.

C. S. MINOT,
W. T. SEDGWICK, } *Committee.*
C. O. WHITMAN,

BOSTON, *Feb.* 23, 1889.

AUDUBON MONUMENT COMMITTEE.—About a year ago we called attention, by means of a circular letter, to a project for erecting a monument to the illustrious naturalist, JOHN JAMES AUDUBON, and requested contributions for that purpose, the expense of the design adopted being estimated at from $6,000 to $10,000.

We have now received about $1,000, and rather than obtain the remaining sum in New York City—as our plan has been from the first to make the Monument a national one—we again call your attention to the matter.

In order to encourage subscriptions, we have obtained reproductions from the best portrait of AUDUBON extant, and will send these, of a size suitable for framing, *to every contributor to the* fund of *one dollar or more.*

Remittances should be sent to the undersigned.—*N. L. Britton, Secretary and Treasurer, Columbia College, New York City.*

The Dutch East India government grants annually $30,000 for the support of the Botanical Garden and Laboratory at Breitenzorg, Java.

It is proposed in Norway to start another North pole expedition in 1890, under the leadership of Dr. Fridjof Nansen.

THE NAUTILUS, a sixteen-page illustrated, octavo, monthly journal of Conchology will take the place of the *Conchologist's Exchange* formerly published by Wm. D. Averell, and will be the successor of that paper.

It will be under the editorial management of Mr. Henry A. Pilsbry, Conservator of the Conchological Section of the Academy of Natural Sciences, and the successor of the late Mr. Tryon in the publication of *The Manual of Conchology*.—*William D. Averell, Mount Airy, Philadelphia, Pa.*

Prof. A. C. Haddon, whose journey to the Antipodes has already been noticed in these pages, is engaged almost as much in anthropological as in zoological investigations. He was recently in Thursday Island, where he finds that the young men know nothing of ancestral conditions, and if observations be not made soon with the aid of the old men it will soon be too late. He will later go to the Louisiades and the neighboring islands, and then again to New Guinea. He will probably stop but a short time in Ceylon.

At a recent meeting of the Academy of Sciences of Paris, Prince Albert of Monaco drew attention to the fact that vessels running short of provisions might obtain food sufficient to support life indefinitely if provided with apparatus for collecting the surface swimming forms.

Dr. Heinrich Alexander Pagenstecher, director of the Museum at Hamburg, died January 5, 1889, of heart disease. Dr. Pagenstecher was long professor of zoology at Heidelberg, and while there wrote his four volumed "Allgemeine Zoologie." He was sixty-three years of age.

Dr. Whitman's *Journal of Morphology* receives, at the hands of Mr. G. P. Howes, well deserved praise in *Nature* for January 10.

M. G. Meninghini, professor of geology at Pisa since 1849, died January 29, aged seventy-eight.

Charles Brogniart has recently found fossil cockroaches of the family Mylacridæ in the Commentry formations of France.

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CONTENTS:

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SEGMENTATION OF THE OVUM, WITH ESPECIAL REFERENCE TO THE MAMMALIA.

BY CHARLES SEDGWICK MINOT.

THERE follows after impregnation a short pause, and then the ovum begins its process of repeated division, which is known as the "*segmentation of the ovum*," the term having been introduced before it was known that each "segment" is a cell. The division or cleavage (Furchung) of ova was described by Prevost and Dumas, 1824, and again by Rusconi in 1836. By usage, the term segmentation is restricted to the production of cells up to the period of development, when the two primitive germ-layers are clearly differentiated and the first trace of organs is beginning to appear.

Segmentation nucleus. The impregnated ovum has a single nucleus which is known as the segmentation nucleus, and which is formed by the union of the male and female pronuclei.[1] It is the parent of all the nuclei subsequently found in the organism, and participates actively in the process of segmentation. It is very much smaller than the nucleus of the egg-

[1] Ed van Beneden in his first paper, Ascaris, **11**, affirmed that there was no real union of the pronuclei in the impregnated ova of that species, but Carnoy, **18**, showed that van Beneden's observations were incomplete, and Zacharias has stated, **50**, that they are so defective as to be fundamentally erroneous in regard to important phases, and he points out that in reality the eggs of Ascaris offer another proof of the actual union of the pronuclei. The impregnation in this Nematod has since formed the subject of numerous articles, see van Beneden and Neyt, **12**, Carnoy, **182**, Boveri, **15**, etc., etc.

cell before maturation ; it is usually membranate, and has numerous fine granules of chromatine, *microsomata*, derived from the pronuclei ; in some cases the microsomata from the male pronucleus are distinguishable from those of female pronucleus. In the rabbit the nucleus when first formed has indistinct contours, an irregular shape and a homogeneous appearance (Ed van Beneden, 8, 699,) it soon enlarges, becomes regular, and acquires a distinct, centrally situated nucleolus, (Bischoff, **14**, 50, Coste **17**, Lapin Pl. ii. fig. 4,) presumably by the gathering together of the microsomata.

The position of the nucleus is always eccentric[1] so far as known, and approximately if not exactly the same as that of the egg-cell nucleus before maturation ; accordingly, the degree of eccentricity varies as the amount of yolk or deutoplasm being least in alecithal and greatest in telolecithal ova. In brief, it may be said the nucleus tends to take the most central position possible with regard to the protoplasm of the ovum. The vitelline granules are not to be regarded as protoplasm, hence their accumulation may produce a one-sided distension without, however, in the least disturbing the uniform *radial* distribution of the protoplasm. The nucleus is surrounded by protoplasm with few or no yolk grains ; in telolecithal ova the perinuclear accumulation is the court of protoplasm at the animal pole.

Period of repose. After the segmentation-nucleus is formed, there occurs a pause, which lasts according to observations on several invertebrates, from half to three quarters of an hour. It is probable that a similar pause ensues in the mammalian ovum, but there are as yet no observations to show whether it occurs or not. During this period the yolk expands slightly, unless, indeed, the expansion observed is due to the influence of hardening agents[2] and the monocentric radiation, which is present when the nuclei copulate, gradually fades out, and is

[1] It is often stated that the nucleus lies exactly in the centre, but I have been unable to find a single observation to justify the statement.

[2] Van Beneden states that osmic acid produces an artificial expansion of the ovum within the zona

replaced by a dicentric radiation which marks the end of the period of repose and the commencement of the first division of the ovum.

Karyokinesis of the ovum. Segmentation is a process of indirect cell division, and nowhere are more perfect karyokinetic figures to be found than in the segmenting ovum. It is, therefore, advisable to give a general account of the changes involved in every division, but inasmuch as karyokinesis is a phenomenon by no means restricted to embryonic cells, it is not one of the special subjects of the embryologist. I shall, therefore, attempt only a summary account, following in the main, O. Hertwig, **26**, 37-38, (compare Rabl's exhaustive memoir, **87**.)

It is probable that the resting nucleus has one pole at which the connection between the reticulum of the nucleus and the surrounding protoplasm is more intimate than elsewhere, as suggested by Rabl, **88**. This pole is marked by a clearer spot outside the nucleus, close against it and much smaller than it. This clear spot becomes the centre of the radiating arrangement of the protoplasm. It was, I believe, first observed by Flemming in the eggs of Echinoderms, has been seen in *Ascaris megalocephala* by van Beneden and Neyt, **12**, and by Boveri, **15**, in Siredon by Kolliker, 28, and in other cases. It is now designated as the sphere of attraction,[1] and is seen, at least in certain phases, to contain a separate central body (centrosoma of Boveri). It is not improbable that the "sphere of attraction" is identical with the *Nebenkern* of recent German writers. In a number of instances a small part of the nucleus is seen to separate off and to lie as a distinct body, *Nebenkern*, alongside the nucleus; this body has a colorable portion which is comparable to the "centrosoma." For an account of the scattered observations on the *Nebenkern*, together with the relation of these bodies to Gaule's so-called cytozoa, see G. Platner, **84**,

[1] The history and significance of the spheres of attraction as here presented cannot, by any means, be regarded as final. The observations are few, and in *most* cases the exact history of the spheres of attraction has received no attention from investigators whatsoever.

for additional observations see Prenant, **85**, and Platner, **84a.**

The sphere of attraction divides, as does also its central body, and its two parts move to opposite sides of the nucleus. There thus appear two opposite accumulations of clear protoplasm, from each of which as a centre, astral rays or radiating lines are formed in the cell-body. Meanwhile, within the nucleus, changes go on; the threads of the intranuclear network radiate out from the the pole where the sphere of attraction lies before its division, and the chromatic substance forms a number of distinct grains. When the sphere of attraction divides and its halves go asunder, the nuclear substance preserves its radiating relation to each sphere, and as the membrane of the nucleus disappears during these changes, the final result of the transformation of the nucleus is a spindle-shaped body, the points of which rest just within the clear centre of each astral system, so that the spindle stretches from one protoplasmic mass to the other. The spindle consists of fine threads extending from pole to pole and having almost no affinity for the dyes of the histologist, a peculiarity which causes them to be known as the achromatic threads. These threads are probably always compounded of a considerable number of exceedingly fine fibrillæ, see Rabl, **88**, 21-22. The colorable substance forms a number of separate grains, each of which is united with one of the achromatic threads, and all of which lie at the same level in the centre of the spindle; when the spindle is seen from the side, the chromatine grains appear to constitute a central band or disc (Strassburger's *Kernplatte*) but when the spindle is seen endwise, the separate grains are at once recognized. The shape of the grains is variable; some authors, without sufficient observational proof, have advanced the opinion that the grains are *always* V-shaped. The spindle together with the polar accumulations of protoplasm and the two accompanying radiations constitute a so-called *amphiastere.*

The domain of the radiation extends, the two protoplasmatic centres move further apart, the nuclear spindle elongates correspondingly, and the chromatic grains of the *Kernplatte*

divide. Flemming maintains that the division is always lengthwise of the V-shaped grain, but this has been controverted by Carnoy. How the division occurs in the mammalian ovum is unknown. By division, however it is effected, the number of chromatine grains is doubled; they form two sets; one set moves toward one pole, the other towards the other pole; the grains of each set keep at the same level as they move, until they reach the end of the spindle, where they appear as a polar disc (Carnoy's couronne polaire). Next the achromatic threads of the spindle break through and are apparently drawn in towards each polar crown. There are now two nuclear masses, each near but not at the centre of a radiation, and each consisting of chromatine and achromatic substance, each mass develops into a complete membranate nucleus, but the steps of this process have yet to be followed in detail in the vertebrate ovum.

The signs of division of the protoplasm usually become visible about the time the polar crowns are formed, but when the ovum contains much deutoplasm the division may be retarded. In the plane which passes through the equator of the nuclear spindle, there appears a furrow on the surface of the ovum, which gradually spreads and deepens until it is a complete fissure around the cell, it cuts in deeper until at last only a thin stalk connects the two halves of the cell, and thereupon the stalk breaks and the cell is divided. There next ensues a pause, during which the astral rays of the protoplasm disappears in the daughter cells, and the daughter nuclei assume each the form of an ordinary resting membranate nucleus.

The external appearances of segmentation in the living ovum vary, of course, especially according to the amount and distribution of the yolk material. The appearances in holoblastic ova with very little yolk are well exemplified by *Limax campestris*. Mark's description, **82**, is, nearly in his own words, as follows:

"In Limax, after impregnation, the region of the segmentation nucleus remains more clear, but all that can be distinguished is a more or less circular ill-defined area, which is less

opaque than the surrounding portions of the vitellus. After a few moments, this area grows less distinct. It finally appears elongated. Very soon this lengthening results in two light spots which are inconspicuous at first, but which increase in size and distinctness, and presently become oval. If the outline of the egg be carefully watched, it is now seen to lengthen gradually in a direction corresponding to the line which joins the spots. As the latter enlarge, the lengthening of the ovum increases, though not very conspicuously. Soon a slight flattening of the surface appears just under the polar globules, the flattening changes to a depression (Fig. 1) which grows deeper and becomes angular. A little later the furrow is seen to have extended around on the sides of the yolk as a shallow depression, reaching something more than half way toward the vegetable or inferior pole, and in four or five minutes after its appearance the depression extends completely around the yolk. This annular constriction now deepens on all sides, but most rapidly at the animal pole; as it deepens it becomes narrower, almost a fissure. By the further deepening of the constriction on all sides there are formed two equal masses, connected by only a slender thread of protoplasm, situated nearer the vegetative than the animal pole, and which soon becomes more attenuated and finally parts. The first cleavage is now accomplished. Both segments undergo changes of form, they approach and flatten out against each other, and after a certain time themselves divide.

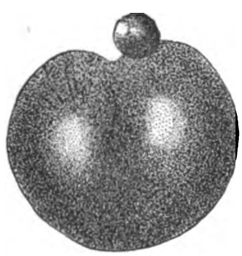


Fig. 1. Ovum of Limax campestris, during the first cleavage. Magnified 200 diameters. The envelopes are not drawn in. (After E. L. Mark.)

Primitive type of segmentation. In the lower animals there is not found that excessive amount of deutoplasm in the ovum which is so characteristic of the vertebrates, and in their ova we have what is undoubtedly the earlier and more primitive type of segmentation. In these cases the cleavage extends as in the egg of Limax, (see above) through the whole of the dividing cell. The two cells first produced are almost if not

quite alike, and each of them produces two cells which are also very similar to one another; then comes a division of the four cells into eight, four of which resemble one another and differ from the remaining cells which are also similar among themselves. Four of the cells are derived chiefly from the substance of the animal pole of the ovum and are very protoplasmic; and the other four cells are constituted out of the substance of the vegetable pole and accordingly contain most of the deutoplasm of the ovum. The eight cells form an irregular spheroid, in the centre of which there is a space between the cells; this space is known as the segmentation cavity.

The four cells of the animal pole progress in their divisions more rapidly than the four of the vegetable pole, but the latter when the yolk matter is at a minimum, as, for instance, in echinoderms, do not lag much. From their unequal rates of division the two sets of cells come to differ more and more in size, those of the animal pole being much the smaller. The division of the cells take place so that the cells form a continuous layer of epithelium, one cell thick, stretching around the enlarged central segmentation cavity, (Fig. 2) and, the latter being an outside view of an Amphioxus blastula, *cf. infra;* the epithelium consists of a larger area of the small cells of the animal pole, and a small area of the large cells of the vegetable pole. This stage of segmentation is known as the blastula stage; the small cells are destined to form the *ectoderm* of the embryo; the large cells the *entoderm;* the central space is the *segmentation-cavity;* the line along which the two parts of the epithelium (ectoderm and entoderm) join is known as the *ectental line.*

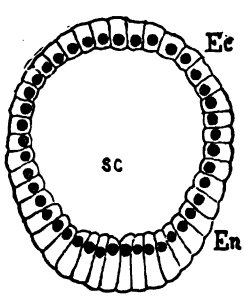


Fig. 2. Blastula of Echinocardium cordatum 20 hours after impregnation *Ec*, ectoderm; *en*, entoderm; *sc*, segmentation cavity. After Selenka.

Vertebrate type of segmentation. In the vertebrates we find that segmentation also results in two epithelia, one ectoderm and one entoderm, joined at their edges, and

surrounding a segmentation-cavity, but the resemblance to the typical blastula is masked by changes in both ectoderm and entoderm; the vertebrate ectoderm when first fully differentiated consists of several layers of cells, and not merely of a single layer of cells as in the primitive type of segmentation; the entoderm contains a very large amount of nutritive material (deutoplasm) and is represented either by a mass of large cells (marsipobranchs, ganoids, amphibians) or a mass of protoplasm, not divided into cells, or but partially divided into cells, and containing an enormous quantity of deutoplasm (sauropsidans and monotremes). In the higher mammals there are further modifications as described below.

The more primitive form among vertebrates is, I think, presumably, that in which the entoderm consists of separate cells, for this mode of segmentation is the one which most resembles that of invertebrates, and it occurs in the lowest vertebrates, and in ova which are not excessively charged with yolk.

In the *primitive form of vertebrate segmentation*, which is preserved in the marsipobranchs, ganoids and amphibians, there is a well marked difference between the cells of the two poles. The following account refers especially to the frog's egg, and is an adaption of Balfour's summary (Comp. Embryl. I., 78, 79). The first formed furrow is vertical; it commences in the upper half of the ovum which corresponds to the animal pole and is characterized by the black pigment—the lower or vegetable pole being whitish. The first furrow extends rapidly through the upper, then more slowly through the lower half of the ovum, so that the divergence in the two polar rates of development is indicated already. As soon as the furrow has cleft the egg into halves, a second vertical furrow appears at right angles to the first and behaves in the same way (Fig. 3). The next furrow is at right angles to both its predecessors, and therefore parallel to the equator of the egg, but it is *much nearer the animal than the vegetative pole.* It extends rapidly around the egg and divides each of the four previous segments into two parts; *one larger with a great deal of yolk, and the other smaller with very little yolk.* The eight segments or cells

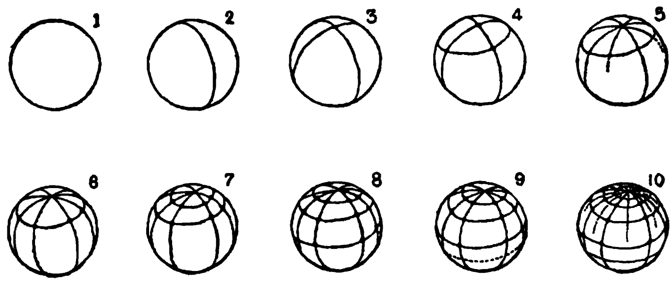


Fig. 3. Segmentation of the egg of the common frog; diagrams slightly modified from Ecker.

have a small segmentation cavity in the centre between them. This cavity increases in size in subsequent stages, its roof being formed by the small cells further divided, and its floor by the large cells, also multiplied by division, though to a less extent than the small cells. All the developmental processes progress more rapidly at the animal pole. After the equatorial furrow, there follows two vertical or meridional furrows which begin at the animal pole and divide each of its four cells into two, making eight small cells. After a short period these furrows extend to the lower pole and divide each of the large cells into two (Fig. 3, 5). The so-called *meridional* cleavages after the first and second are not truly meridional cleavages since they do not pass through the pole of the ovum, but through the poles of the cells, (blastomeres) which they divide; see Rauber, Morph. Jahrb. viii, 287.

A pause now ensues, after which the eight upper cells become divided by a furrow parallel to the equator and *somewhat later* a similar furrow divides the eight lower segments. Each of the small cells is now again divided by a vertical furrow, which later divides also the corresponding large cell. The segmentation cavity is, therefore, now bounded by 32 small and 32 large cells. After this the upper cells (ectoderm) gain more and more in number beyond the lower cells (entoderm). After the 64 segments are formed, two equatorial furrows appear in the upper pole before a fresh furrow arises in the lower, making 128 ectodermal cells against only 32 entodermal.

The regularity of the cleavage cannot be followed further, but the upper pole continues to undergo a more rapid segmentation than the lower. At the close of segmentation the egg forms a sphere, containing an excentric segmentation cavity (Fig. 4, *s. c.*) composed of two unequal parts, an upper arch of several layers of cells, (*Bl.*) the primitive blastoderm of Minot or ectoderm, and a lower mass (*Yolk*) of large cells rich in protoplasm. At the edge of the mass of large cells (*k w*) there is a gradual passage in size to the cells of the blastoderm, and it appears that the small cells receive additions at the expense of the large ones; this zone corresponds to the so-called germinal wall of large vertebrate ova, and also to what we have defined as the ectental line.

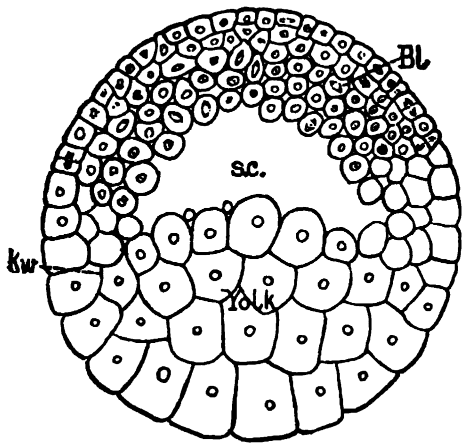


Fig. 4. Section of the segmental ovum axoloth, after Belloni, *Bl.* blastoderm; *s. c.* segmentation cavity; Yolk, yolk or entoderm; *k. w.* (keim wall) germinal wall.

The *secondary type of vertebrate segmentation* differs from the primary principally in the retarded development of the entoderm, due, apparently, to the increase of the yolk-matter. The yolk granules are, as already mentioned, found to be situated not quite exclusively, though almost so, in those parts of the ovum out of which the entodermal cells are formed. Hence, when there is a great deal of yolk the anlage of the entoderm becomes bulky, and when it segments the entodermal cells it produces are correspondingly big, as we have seen is the case in Amphibian ova. On the other hand, when the amount of yolk is small, as in the primitive type of segmentation, *e. g.* echinoderms, the entodermal cells are small. In the reverse case when the amount of yolk is exceedingly great, as in se-

lachians, reptiles and birds, the yolk may not divide into cells as fast as the nuclei multiply, so that it seems that the presence of the deutoplasm, though it does not affect the nuclear divisions markedly, certainly impedes very much the division of the protoplasm, and consequently in these ova we find at certain stages of development a multinucleate yolk. The impediment is not encountered by the protoplasm of the animal pole, hence we see the animal pole segmenting while the yolk does not; in this case the segmentation appears confined to one portion of the ovum, and accordingly such ova are termed *meroblastic* in contradiction to the *holoblastic* ova, in which the first cleavage furrows divide the whole ovum; but the difference, it must be expressly remembered, is one of degree not of kind.

The best known example of a vertebrate meroblastic ovum is, undoubtedly, the hen's egg. The so-called yolk or "yellow" is the ovum; the white and the shell are both adventitious envelopes added by the oviduct as the ovum passes down after leaving the ovary. The segmentation begins while the ovum is passing down through the lower part of the oviduct, and shortly before the formation of the shell commences. If an ovum from the upper part of the oviduct be examined, it is found to be surrounded with more or less white (albumen). Its animal pole is represented by a whitish disk from 2.5—3.5 mm. in diameter and 0.30—0.35 mm. in thickness; this disc is known by many names— formative yolk, germinal disc, cicatricula, (Narbe, Hahnentritt, Keimscheibe, stratum s. discus proligerus). The animal pole consists chiefly of protoplasm and is peculiar only in its small size compared with the whole ovum; it contains, when the ovum leaves the ovary, the egg-cell nucleus; the ovum then matures; impregnation occursand finally segmentation begins. Viewing the ovum from above, we see the first furrow appear as a groove running across the germinal disc, though not for its whole width, and dividing it into halves; this furrow is developed in accompaniment with the division of the segmentation nucleus. The primary furrow is succeeded by a second furrow nearly at right angles to the

first; the surface of the germinal disc is cut up into four segments or quadrants, (Fig. 5, A.) which are not, however, separated from the underlying substance. The number of radiating furrows increases from four, to seven or nine, when there arises a series of irregular cross furrows, by which the central portion of each segment is cut off from the peripheral portion giving rise to the appearance illustrated by Fig. 5, C; there are now a number of small central segments surrounded by large, wedge-shaped external segments. Division of the segments proceeds rapidly by means of furrows running in va-

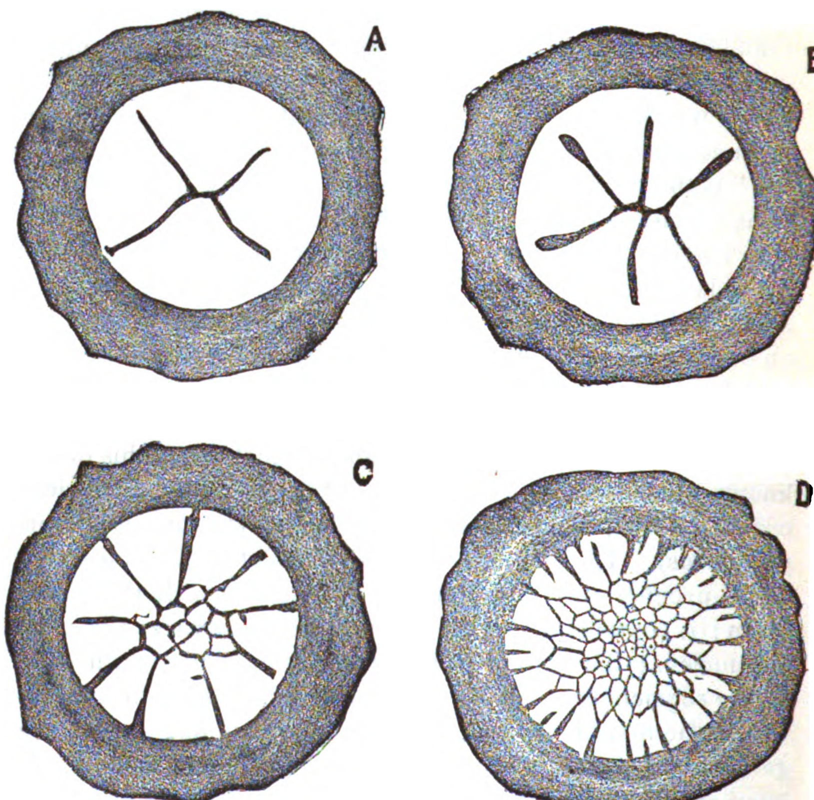


Fig. 5. Four stages of the segmentation of the hen's ovum; after Coste. Only the germinal disc seen from above and part of the surrounding yellow yolk are represented.

rious directions. Not only are the small central segments divided into still smaller ones, (Fig. 5, D.) but their number is increased also by the addition of cells cleft off from the central ends of the large peripheral segments, which are themselves subdivided by additional radiating furrows (Fig. 5, D.). Sections of the hardened germinal disc show that segmentation is not confined to the surface, but extends through the protoplasmic mass of the animal pole, there being deep seated cleavage in planes parallel to the surface of the ovum. According to Duval, **19**, when the first few, small central cells are separated off there is a small space between them and the underlying egg substance (see Figs. 2, 3, 4, 5 and 6 of his Plate I.) and this space he calls the segmentation cavity; but in this, I think, he is in error, for the cells formed below this space are incorporated in the ectoderm or primitive blastoderm; the cells referred to are those marked *im*, in Fig. 8 of Duval's Pl. I. The true segmentation cavity, as we have seen, is bounded on one side by entoderm. This fundamental characteristic Duval has entirely overlooked. From the processes described, there results a disc of cells, which receives peripheral additions; the border from which these additions come is known as the *segmenting zone*. The whole mass of cells derived from the germinal disc represents the ectoderm, and the segmenting zone may be homologized with the cells around the edge of the primitive blastoderm of the frog (Fig. 4, *k w*). A section through the segmented germinal disc shows the following relations: The blastoderm is a disc of cells; its upper layer is epithelioid, its lower layers consists of rounded cells more or less irregularly disposed; at its edge it merges into the yolk which continues to produce cells; between the blastoderm and the yolk is a fissure—the segmentation cavity; the yolk under the fissure contains a few nuclei, which have each a little protoplasm about them, but do not form parts of discrete cells.

In reptiles, the process of segmentation is very similar to that in birds. Our knowledge is based principally upon observations upon the eggs of the European lizards (*Lacerta agilis* and *viridis*) which have been studied by Kupffer and Benecke,

30, Balfour, **2,** Sarasin, **41,** Weldon, **49,** and Hofmann Archives ne'erlandaises xvi, 1881) Hofmann gives a resumé) in Broun's Thierreich vi. Abth. iii. p. 1877-1881. The process is more irregular, and small cells are budded off singly and in scattered clusters from the larger segments. At the close of segmentation the germinal disc is converted into a membrane consisting of several layers of cells and parted from the underlying yolk by a thin space—the segmentation cavity; at its edge this membrane, the primitive blastoderm, is united with the yolk, it being immediately surrounded by a segmentating zone, from which it receives accretions. The layer of the yolk immediately under the segmentation cavity contains scattered nuclei, lying singly or in clusters; each nucleus is surrounded by protoplasm; the nuclei are not all alike; some are very large round with very distinct nuclear threads; others are small and often bizarre in shape; probably the latter are budded off from the former.

In Elasmobranchs, the germinal disc is thicker, and consequently the mass of cells resulting from its segmentation cuts in quite deeply into the yolk, Balfour, Comp. Embryol. i, fig. 46, Rückert, **40,** 28. As segmentation progresses, the cells spread out into a layer, which shows the same essential relations as have been described in birds and reptiles. There is the several-layered primitive blastoderm with its edges connected with the yolk and itself overlying the segmentation cavity, the lower floor of which is formed by the multinucleate yolk the representative of the cellular yolk mass of the frog (Fig. 4, *Yolk*). The nuclei are confined to the layer immediately under the segmentation cavity, and this layer corresponds to the sub-germinal plate in teleost ova. Of the yolk-nuclei some are large, others are small as in reptiles; they are the *Parablast-kerne* of His, the *Merocyten-kerne* of Rückert.

In bony fishes, also, we find the same type, but modified somewhat. The process of segmentation has been very carefully studied by C. O. Whitman, **1,** to whom I am indebted for the accompanying semi-diagrammatic figure of the segmented ovum of a flounder. The ovum is surrounded by a vitelline membrane, *z*, from which it has slightly withdrawn,

notably at the upper pole, where lies the thick cap of cells constituting the blastoderm, *Bl.*; in the stage represented, the outer layer of cells is just beginning to assume an epithelioid character; underneath the blastoderm is the well-marked segmentation cavity, *s. c.*; everywhere at the edge of the blastoderm lies the segmenting zone, *k. w.*, a ring of granular protoplasm with rapidly dividing nuclei; the cells resulting from these divisions are added to the edge of the blastoderm, which thus enlarges peripherally. The protoplasm of the segmenting zone is prolonged inwards forming the floor of the segmentation cavity; this sheet of protoplasm *s. g.*, is known as the *sub-germinal plate.*

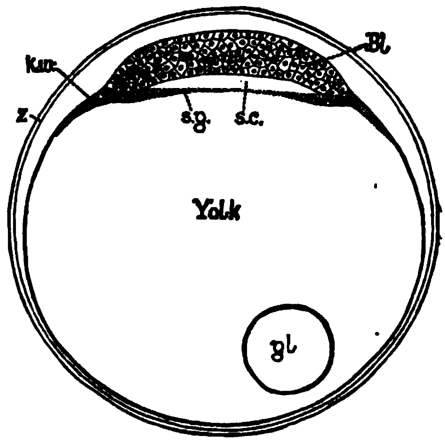


Fig. 6. Ovum of a flounder in transverse vertical section; semi-diagrammatic figure by Dr. C. O. Whitman. *z.* vitelline membrane (or zona); *k.w.* segmenting zone (keim wall); *Bl.* blastoderm or primitive ectoderm; *s. c.* segmentation cavity; *s. g.* sub-germinal plate, *gl.* oil globule of yolk.

The segmenting zone is, of course, the homologue of the similar zone in amniote ova, or the so-called germinal wall, but it is quite sharply defined against the yolk and therein differs from the wall in the chick, because in the latter the germinal merges gradually into the yolk. The process of segmentation differs from that in elasmobranchs and sauropsida, in that the cleavage of the germinal disc is strikingly regular, and further in that the whole width and thickness of the germinal disc is involved in the segmentation from the very start. The segmentation in teleosts is further interesting as affording proof that all the nuclei as shown by Whitman's investigations, arise from the segmentation nucleus.

To summarize: In vertebrate ova with a large yolk which does not divide into cells until segmentation is considerably advanced, the substance of the animal pole segments com–

pletely and produces several layers of cells (the uppermost becoming epithelioid), which are the ectoderm or primitive blastoderm ; the edge of the blastoderm touches the yolk and is surrounded by a nucleated zone in which the production of cells is continuing ; underneath the blastoderm is the fissure-like segmentation cavity ; the floor of this cavity is formed by the unsegmentated yolk (entoderm) which is furnished with scattered nuclei in the layer immediately under the segmentation cavity ; the yolk nuclei, at least in selachians and reptiles, are of two kinds, very large ones and smaller ones, which arise, probably, from the large nuclei ; the nucleated layer may be termed the sub-germinal plate.

Modified segmentation of placental mammals. The lowest mammals resemble the reptiles in many respects ; amongst other reptilian characteristics of the monotremes, we find ova of large size and rich in deutoplasm. That these ova segment during their passage through the oviduct, in similar manner to those of reptiles, was first ascertained by direct observation by Caldwell in 1884, **16.**

In marsupials and the placental mammalia the amount of yolk substance is greatly reduced and the ovum is of small size. It is, therefore, holoblastic, that is to say, the cleavage planes cut through the entire cell, as in the primitive type of segmentation, but the arrangement of the cells at the close of segmentation appears to be a direct inheritance from the reptilian ancestors of the mammals.

Fig 7. Ovum of a rabbit of twenty-four hours; after Coste. The first cleavage has been completed; the two cells are appressed; above the cells lie the polar globules; numerous spermatoza lie in and within the zona pellucida.

The segmentation of the mammalian ovum was first clearly recognized by Bischoff, though it had been previously seen and misinterpreted by Barry, **5, 6, 7**; very beautiful figures of segmentation in the rabbit have been given by Coste, **17.** More recently, observations have been published by Hensen on the rabbit, **24,** van Beneden on the rab-

PLATE XVII.

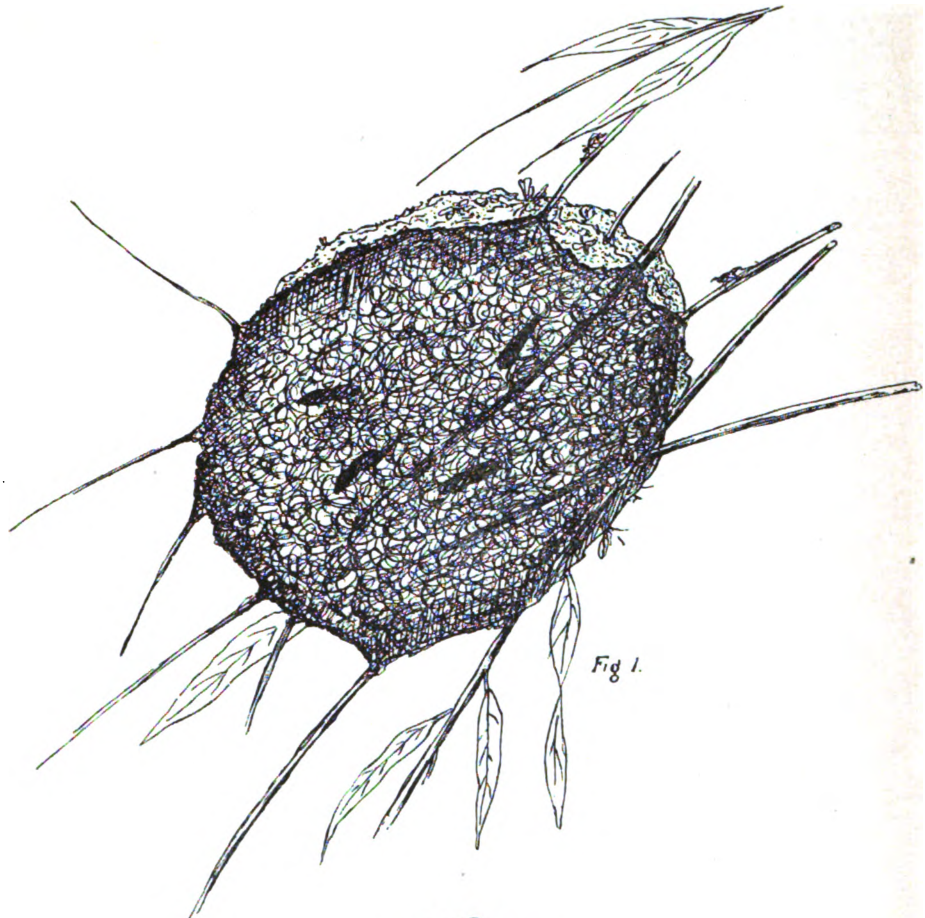


Fig 1.

Fig 2.

Nest of Arboreal Batrachian.

bit, **8, 9, 10,** Kupffer on rodents, **29,** Selenka on rodents, **44, 45, 46,** and oppossums, **47,** van Beneden and Julin on bats, **18,** Heape on moles, **28,** Tafani on white mice, **48.**

The ovum, when discharged from the ovary, is surrounded by the corona radiata, which is lost when impregnation takes place. Segmentation begins when the ovum is one-half to two-thirds of the way through the oviduct. The ovum spends about 70 hours in the oviduct in the rabbit, and about eight days in the dog. The first cleavage plane passes through the axis of the ovum which is marked by the polar globules. When first formed, the two segmentation spheres are oval and entirely separated from one another, but subsequently they flatten against one another and become appressed—a remarkable phenomenon of which we possess no explanation whatever. The second cleavage plane is also meridional.

The ovum next divides into eight and then into twelve segments, of which four are larger than the rest.

The succeeding cleavages have never been followed accurately, but from Heape's observations on the mole, **28,** 166, we know that the divisions progress with great irregularity, and is probable that the commonly assumed regularity of mammalian segmentation does not exist in nature. After a time (in the rabbit about 70 hours) there is reached the stage termed *Metagastrula* by van Beneden, **10,** 153-160, in accordance with his view of the homologies of this stage. The metagastrula consists of a single layer of cuboidal hyaline cells lying close against the zona pellucida (Fig. 8) *en;* the space within this layer contains an inner

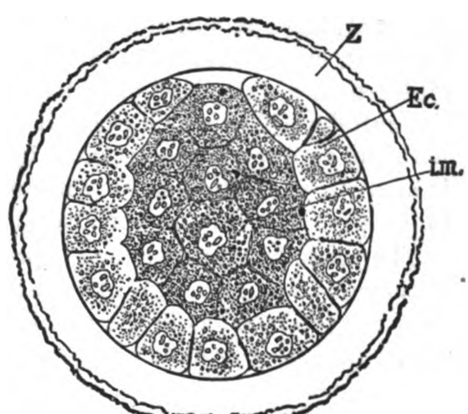


Fig. 8. Rabbit's ovum of about 70 hours; after E. van Beneden. *z.* Zona pellucida; *en.* [entoderm; *i. m.* inner mass of granular cells.

mass of cells, *im*, which are rounded or polyzonal and densely granular. At one point the outer layer is interrupted and the space is filled by *one* of the granular segments of the inner mass (Fig. 8). The nuclei of all the cells are somewhat nodulated, and have several highly refractible granules each. The granules in the bodies of the cells of the outer layer are somewhat concentrated around the nucleus, leaving the cortices of the cells clear, van Beneden, **9,** 28-29, has observed that sometimes (21 oval out of 29) the first two segmentation spheres are of unequal size in the rabbit, and similar variability occurs in the mioe, Heape, **28,** 165 ; Tafani, on the other hand, expressly denies its occurence in white mice. It is, I think, very improbable that this difference, which sometimes occurs and sometimes does not, has any fundamental significance ; van Beneden, however, has maintained that the small cell gives rise in the rabbit to the inner mass of cells, (see below) which he terms the entoderm, but which must, it seem to me, be homologized with the ectoderm, as explained below. That van Beneden is in error, as to the genetic relation of the small cell to the inner mass has been demonstrated by Heape, **28,** 166.

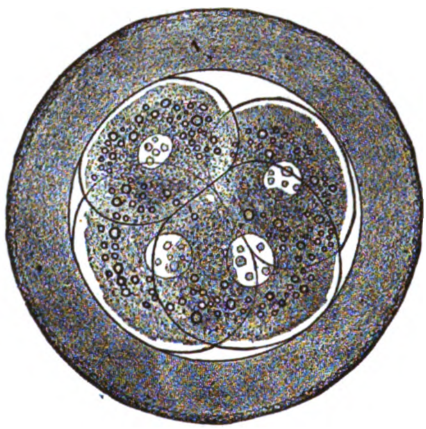


Fig. 9. Ovum of a bat, Vespertilio murina, with four segmentation spheres; after van Beneden and Julin.

The second cleavage plane is probably also meridional, and is certainly at right angles to the first, so that four similar cells are produced as in the primitive type of segmentation,[1] (Fig. 9) those four cells are also rounded at first, and probably become fitted against one another so as to produce the

[1] **The distinction here made between "primitive type of segmentation" an "primitive type of *vertebrate* segmentation" should be borne in mind by the reader.**

disposition observed by Tafani 1889, 48, 116, in mice ova at this stage; Tafani describes each cell as having the form of a three-sided pyramid with the apex at the centre of the ovum and a convex base forming part of the external surface of the yolk. That the two first cleavage planes are meridional is rendered probable by the arrangement in the four cell stage observed by Selenka in the Virginian oppossum. (Fig. 10.)

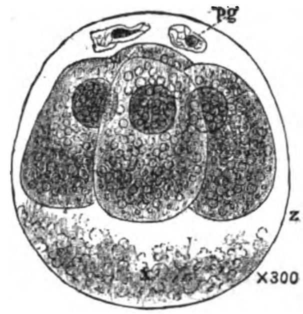


Fig. 10. Ovum of Virginian oppossum with four segments; after Selenka.

(To be continued.)

THE SONG OF THE SINGING MOUSE.

BY. WM. T. DAVIS.

IN the daily papers and in scientific journals references to singing mice are not uncommon, some relating to wild species, but generally to the house mouse. The authors of these notices usually refer to the mice as singing from happy choice, as if they greatly enjoyed their own music, and in captivity, they have been reported as singing when food was given them, or when turning the wheel, as expressive of delight and high spirits. In some cases a mouse may be able to sing at will, but I think, from the descriptions I have read, that it is generally involuntary, as it certainly was in the individual that came under my own observation.

Several years ago, in November, I heard a strange noise near some water pipes in a store room, and at first thought that one of them had broken, and that a little stream was gurgling between the walls. However, later on, this gurgling noise was found to be produced by a mouse, which ran from behind various boxes as they were, in turn, removed, keeping up a constant song. A trap was set, and after a few days the mouse was captured. In the meantime, it was heard at inter-

vals, from cellar to garret, as this tell-tale song gave notice of its wanderings.

When removing it from the trap to the cage, and many times afterward, it ran about a small room, and the most noticeable feature on these occasions was the unvaried song, it being especially loud if I caused the mouse to scamper around the room several times without stopping. When gnawing on the exposed wood in the cage, when eating, or when disturbed in its nest, this singing was also particularly loud; in fact, upon any exertion, the song was produced, varying in volume in proportion to the amount of exercise.

On Thanksgiving day, eleven days after her capture, my mouse had two young, poor, miserable, little creatures, but, nevertheless, able to squeak and make considerable noise. It was just previous to, and for some time after the birth of these young, that *Mus* sang most continuously.

The young grew apace, and on December 14th, one was looking out of the nest, while the mother kept up a constant singing, probably being much excited thereby. At this stage the baby mice were funny little bodies, sparsely covered with hair and the dimensions of a respectable peanut. On the 19th, both of the young mice were out of the nest, and one was quite helpless, laying on his back kicking and panting after he had tumbled about the cage. I was afraid he would be unable to get into the nest again, so I rendered some assistance. However, in about fifteen minutes he was out as before, tumbling about in just the same rough manner, the mother all the while keeping up a constant singing, and alternately running in and out of the nest. After a time she picked up the little mouse by the side of the neck, carried it across the cage and put it in the nest, and I did not see it again. The other baby mouse was quite able to care for itself.

On December 21st the mother mouse ate about half of one of her offspring, commencing at the head. The one devoured was the most backward of the two, and I found the lively fellow, on this occasion, at the other end of the cage, the most distant point from his mother. I have had a full-grown *Hes-*

peromys mouse eat a large portion of one of the same species, though there was plenty of food in the cage at the time; and, as with this *Mus*, it started its cannibalistic operations with the head of its companion.

These two mice were not very good specimens as mice go. The mother was small and thin and her offspring, at first, equally miserable in appearance; but an abundant food supply finally bettered their condition. Fourteen more young, divided into four litters, were born to this musical rodent in the course of the year and seven months of her captivity, and the incidents detailed in the account of the first were repeated with slight variations. One morning it was discovered that the singer had devoured her spouse, though, be it said in her favor, he may have died first. The family was thus broken up, and the probable cause, in consequence, transferred to a bottle of alcohol, where she at present remains.

As I have said, it was the time at which the mouse was the weakest, when made to exercise greatly and breath fast, that the singing was chiefly noticeable, and I think a few quotations from some other notes on the subject will tend in the same direction. Mr. Wm. H. Edwards, in the AMERICAN NATURALIST, Vol. III., p. 551, says: "The captive seemed pleased with his quarters, and soon manifested his content at the quality and regularity of his rations by singing his unvarying tune at all hours." When ejected from his bed "he would manifest his displeasure by flying across the cage into the wheel, which he would make spin, emitting all the while his peculiar note with great shrillness and rapidity."

The Rev. Samuel Lockwood, in his note on "A Singing Hesperomys," printed in the AMERICAN NATURALIST, says: "A very noticeable fact was that a great deal of the little creature's song was poured forth while at play—that is, while in actual activity, and take the wheel-play, for instance, when really in quite violent exercise. A thing, too, which much surprised me was that often when eating she sang and eat at the same time, literally in the same breath." Mr. Lockwood thought that this last might be suggestive of a physiological

difficulty, but he nevertheless gives reasons, under four heads, to disprove the disease theory, and says in the fourth that "she can sing and eat at the same time."

From the facts given above it will be observed how the circumstances under which these mice sang agreed: when ejected from bed, when eating or gnawing, and, as I have shown, when forced to run rapidly about a room, in which act there could be no pleasure. Neither was it happy feelings that prompted the song when I meddled with her babies, when she cowered at the other end of the cage, evincing all the anxiety that is usually shown by animals under such circumstances. In birds we know the cause of song for rivalry or for pleasure, but we always hear quite other notes than those expressive of pleasure, when we look at their precious eggs.

EDITOR'S TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

As suggestions looking to the adoption of some flower as emblematic of our country are now being made, we present some opinions on the topic. The conditions to be satisfied are: 1st, that the flower shall be conspicuous; 2d, that it shall be available for architectural carving; and 3d, that it shall be characteristically American. These conditions exclude many plants that have been named. Propositions in favor of introduced plants, such as the Convolvulus, are out of the question. Members of the Compositæ are mostly undistinguishable in sculpture, and such forms as the golden-rod, which has met with much favor, are unavailable for architecture. The mountain laurel (Rhododendron), is objectionable, since the genus is widely distributed in other regions; and the same objection holds true of the Magnolias. The Indian Corn and the Sweet Gum (Liquidambar) are both destitute of conspicuous flowers. We wish to call attention to two species which satisfy all the conditions. These are the *Kalmia latifolia* ("laurel"), and the *Liriodendron tulipifera* ("tulip-tree"). Both are of wide distribution; both are conspicuous in various

ways, and both belong to genera exclusively North American. Both lend themselves well to the sculptor's art. Between them there is little choice, but we rather lean to the tulip-tree, which, besides its conspicuous flowers and very characteristic leaves, is one of the monarchs of our woods. It thus well represents our characteristic richness in forests, and expresses, figuratively, the strength and greatness of our country.

The scientific editor of the *New York Tribune* will be probably on hand at the Toronto meeting of the American Association for the Advancement of Science, to misrepresent the science of the United States. According to this luminary, the only important scientific meeting held in America up to 1884, was that of the British Association at Montreal that year. As Toronto is not on American soil, he will probably find this year's meeting the next most important. The left-handed compliments paid by this gentlemen to American science will, perhaps, suggest to the readers of his articles that the mind of their author acts inversely as the square of the distance of its objects. We wish we could find an integration of the matter of these articles at all correspondent to the dissipation of energy wasted in writing them.

RECENT LITERATURE.

SCUDDER'S MESOZOIC COCKROACHES.[1]—On comparing mesozoic with palæozoic cockroaches the author finds the fundamental distinction is in the change which the principal nervures of the upper wings have undergone, by the basal or total amalgamation of some of them—a change which reaches its culmination in living species. In the basis of these differences he divides the mesozoic cockroaches into three groups: *a*, those in which only the mediastinal and scapular veins are amalgamated; *b*, those in which the externomedian is united with one of the veins on either side of it; *c*, those in which either

[1] A Review of Mesozoic Cockroaches. By Samuel H. Scudder: Extract from the Memoirs of the Boston Society of Natural History. 1886.

the mediastinal, scapular, and externomedian veins are all united, or there are two lines of union, one between the mediastinal and scapular, and the other between the externomedian and internomedian veins. There are fifty species (28 sp. nov.) figured and described in detail. These are referred to seventeen species, four of which are new.

LYDEKKER'S FAUNA OF THE KARNUL CAVES.[1]—This quarto, of 57 pages and 5 plates, belongs to the series of Palæontologia Indica. The author describes remains of 42 mammals, 8 birds, 5 reptiles, 1 toad, and 9 mollusks. Of the larger mammals no complete skulls were found; only detached teeth, fragments of jaws, and more or less imperfect limb bones. Of the smaller mammals skulls were found in some instances. The remarkable feature in the mammalian remains is the occurrence of a *Cynocephalus*, which may be identical with a living African species; of *Hyæna crocuta*; of a small equus, indistinguishable from *E. asinus*; and of a *Manis*, apparently identical with the existing West African species, *M. gigantea*. The author considers the occurrence of these forms extremely important in supplementing the evidence afforded by the Siwalik fauna as to the probable derivation of many of the existing Ethiopian mammals from those of the later tertiaries of India.

BRANNER'S CRETACEOUS AND TERTIARY GEOLOGY OF THE SERGIPE-ALAGÔAS BASIN OF BRAZIL.[2]—The author states that the importance of this region is due to (1) The representation of a geological range unusual in Brazil: (2) The rich fossiliferous nature of many of its beds; (3) The accessibility of good exposure across the entire section. He is of the opinion that the key to future successful geologic work in Brazil lies in the careful study and comprehension of some such typical region as that comprised in the provinces of Sergipe and Alagôas. Although much of this paper is of a statistical nature, it will be found extremely interesting by the general reader as well as by the special student.

[1] The Fauna of the Karnul Caves. By R. Lydekker, B. A., F. G. S., etc. Extract Memoirs of the Geol. Survey of India, Vol. IV., Part II. 1886.

[2] The Cretaceous and Tertiary Geology of the Sergipe-Alagôas Basin of Brazil. By John C. Branner, Ph. D. Extract from Trans. Am. Philosoph. Soc., Vol. XVI., 1889.

HULL'S GEOLOGICAL AGE OF THE NORTH ATLANTIC OCEAN.[1]—A quarto of 12 pages illustrated by 3 sketch maps and several sectional drawings. The author opposes the doctrine of the permanency of oceans and continents, held by Dana, Le Conte and Dr. Wallace, and cites facts derived from observations in the region of the North Atlantic to uphold Lyell's views of the repeated interchange of oceans and continents. He refers the date of the oceanic condition of the Atlantic area, and of the continental conditions of Eastern America and Western Europe to the close of the Palæozoic epoch.

BOULENGER'S REPTILES AND BATRACHIANS OF THE SOLOMON ISLANDS.[2]—The position of this group of islands, on the limits of two great zoological districts, renders the study of its fauna of special interest, as it is the point where many of the Papuasian and Polynesian forms intermingle. The author gives a list of all the species hitherto found in the Solomon group, with notes on the general habitats. It includes nineteen reptiles and nine batrachians, some of which are restricted to these islands. The plates are admirable in every respect; the drawing is spirited, most of the batrachians especially so. The most remarkable discovery recorded is that of the genus Ceratobatrachus Boul, a form which represents in the Firmisternial Salientia the Hemiphractus of the Arciferous line. The parallel is shown in the mandibular teeth and the huge dermo-ossification of the head. This discovery nearly completes the parallels between the Arcifera and the Firmisternia.

BENNETT AND MURRAY'S CRYPTOGAMIC BOTANY.[3]—As stated in the Introduction, "No general hand-book of cryptogamic botany has appeared in the English language since the Rev. M. J. Berkley's in 1857." In this period, almost one-third of a century, since the preparation of that famous and

[1] On the Geological Age of the North Atlantic Ocean. By Edward Hull, LL D., F.R.S., F.G.S., Director of the Geol. Sur. of Ireland. Extract from the Scientific Trans. Roy. Dublin Soc., Vol. III., 1885.

[2] On the Reptiles and Batrachians of the Solomon Islands. By G. A. Boulenger, F.Z.S. Extract from Trans. Zool. Soc., Vol. XII., 1886.

[3] *A Handbook of Cryptogamic Botany*. By Alfred W. Bennett, M.A., B.Sc., F.L.S., Lecturer on Botany at St. Thomas' Hospital; and George Murray, F.L.S., Senior Assistant, Department of Botany, British Museum, and Examiner in Botany, Glasgow University. With 378 Illustrations. London: Longmans, Guerny and Co.; and New York: 15 East 16th Street. 1889. All rights reserved. 12mo, pp. viii., 473.

useful book, cryptogamic botany "has gone through little less than a revolution." The present work is an attempt to bring within reach of botanists an acquaintance with the present state of our knowledge of this branch of science. How fully the authors have succeeded trial alone will tell. That they have made a useful book is evident at a mere glance.

The general plan of the work may be made out from the following general subdivisions of the subject, which correspond to unnumbered chapters in the book, viz.: Vascular Cryptogamia; Muscineæ; Characeæ; Algæ; Fungi; Mycetozoa; Protophyta. As will be seen, the work begins with the higher forms and passes to the lower, a plan defended by the authors by the statement that "to the general student 'from the known to the unknown' is a very sound principle." They say, however, that, "had our purpose been to construct, theoretically, a genealogical tree for the lower forms of vegetable life, the former course (commencing at the bottom) must necessarily have been pursued, and in the labor in favor of proceeding from the simple to the more complicated types." From which one would infer that this book is useful only to the general student. It will, on the contrary, prove a useful handbook for the laboratory student, in spite of its erroneous plan. Had our authors commenced with the lower plants, and worked up from them, they would have made their book still more useful, not only to the scientific student, but in according to our observation, to the "general student" as well.

Again, it is seen that there is here a partial "reversion to the time-honored division" of the lower plants, whereby the Algæ and the Fungi are recognized as natural groups. It is only a partial reversion, however, and botanists of the old school will scarcely recognize in the modern groups, the older ones of the same names. The Algæ suffer the loss of the Characeæ, the Protococcoideæ, the Diatomaceæ, and the Cyanophyceæ, while the Fungi lose the Myxomycetes, the Acvasieæ, and the Schizomycetes, and are augmented by having swallowed bodily the whole of the Lichens.

A feature of the work, which is to be especially commended, is the very general Anglicizing of terms; *e. g. sporange* for *sporangium; archegone* for *archegonium; antherid* for *antheridium*, etc., etc.

The amount of space assigned to each group is as follows: Vascular Cryptogamy, 122; Muscineæ, 40; Algæ (in the widest sense), 174; Fungi (in the widest sense), 110. Berke-

ley's proportions were better; he gave to each of his groups space as follows: Filicales, 58 pages; Muscales, 77; Fungales, 185; Algales, 156. It may be remarked also that Berkeley's order is the reverse of that adopted in the book under consideration.

There are many points which might be critically discussed in this book; naturally so, because its enforced brevity compels a summary treatment, in which the names of things are not fully given. But we have sufficiently indicated the general character of the work, which will unquestionably be very useful.—*Charles E. Bessey.*

BASTIN'S BOTANY.[1]—This book is a revised and enlarged edition of Professor Bastin's "Elements of Botany," which appeared a couple of years ago. The enlargement has greatly improved what was a good book to start with, and in the volume before us we have a nicely gotten up and useful work. Following in part the older ideas, toward which there is now an evident return among botanists, the author devotes thirteen chapters to Organography, which is, in fact, the organography of the flowering plants alone. The student will be likely (unless corrected by his teacher) to get somewhat warped notions as to the vegetative organs, and the organs of reproduction in the vegetable kingdom, from these 120 pages of introductory matter.

Then follow three chapters (aggregating about 100 pages) devoted to vegetable histology, in which the cell, plant tissues, and tissue systems are discussed. About 40 pages of Vegetable Physiology follow, and the remainder of the book is taken up with a brief survey of the vegetable kingdom, from the Myxomycetes to the Spermaphytes, and two brief chapters on the succession of vegetable life. There is also a glossary of about 30 pages, and a full index.—*Charles E. Bessey.*

DYER'S FOLK-LORE OF PLANTS.[2]—This is not a botanical book, unless we interpret liberally that very liberal definition of botany which declares it to include "every inquiry about

[1] *College Botany*, including Organography, Vegetable Histology, Vegetable Physiology, and Vegetable Taxonomy, with a brief account of the Succession of Plants in Geologic Time, and a glossary of Botanical Leaves. By Edson S. Bastin, A.M., F.R.M.S., Professor of Botany, Materia Medica and Microscopy in the Chicago College of Pharmacy. Chicago: G. P. Engelhard & Co., 1889. 8vo, pp. xvi. 451, with 579 Figures in the text.

[2] *The Folk-Lore of Plants.* By T. F. Thiselton Dyer. New York: D. Appleton & Company. 1889. 12mo, 328 pp.

every plant." The book before us is written in twenty-three chapters, devoted to such topics as Plant Worship, Plants in Witchcraft, Plants in Fairy-Lore, Love-Charms, Dream-Plants, Plant Language, Plants and their Legendery History, etc., etc. A few titles have a faint botanical color, as: Plants and the Weather, Plant Names, and Plants in Folk-Medicine, but it is very faint, indeed. Under the first, which certainly admits of at least a semi-scientific treatment, we have such rhymes as

"Sow peas and beans in the wane of the moon.
Who soweth them earlier, he soweth too soon.
That they with the plant may rest and rise,
And flourish with bearing, most plentiful wise."

And

"Many haws
Many snaws."

And again:

"When the aspen leaves are no bigger than our nail,
Is the time to look out for truff and peel."

In the chapter on plant names the treatment is better, but in that on Folk-Medicine we drop into poetry again, *e. g.*:

"Eat an apple going to bed,
Make the doctor beg his bread."

And

"The fair maid who, the first of May,
Goes to the fields at break of day,
And washes in dew from the hawthorn tree.
Will ever after handsome be."

Now, although this is not a botanical book, and while to a botanist many of its pages seem trash, yet for those for whom it was written the work is well done, and will be welcomed by many a reader.—*Charles E. Bessey.*

GEOLOGY AND PALÆONTOLOGY.

MARSH ON CRETACEOUS MAMMALIA.[1]—Professor O. C. Marsh has been successful in obtaining the teeth and bones of a number of species additional to the *Meniscoëssus conquistus* Cope, discovered by Wortman in 1882. The remains described have been found separate and fragmentary, and they indicate several species of small size belonging to the Multituberculata

[1] Discovery of Cretaceous Mammalia. By O. C. Marsh. *Amer. Journal Sci. Arts*, July and August Nos., 1889, pp. 81-177.

and to the Bunotheria. The former are typical members of the order, while though it is at yet difficult to locate the latter with certainty, they display no dental characters not found in the Creodonta. No Condylarthra have been as yet obtained, a fact which so far indicates the distinction between the faunæ of the Laramie and Puerco epochs. Apart from this, the fossils strongly resemble those of the Puerco, and detract nothing from the supposition which I have entertained that the latter fauna belongs to the Mesozoic series. It is needless to say that the position which I assumed in 1869, that the Laramie belongs to the Cretaceous system, and is not Cænozoic, is fully sustained.

The manner in which Professor Marsh has done this work requires notice. The most superficial knowledge of the subject would have shown him that the molar teeth which he has described as representing distinct genera belong mostly to different parts of the series of the same genus, and often species, and not unlikely, individuals. Thus, supposing superior anterior molars to be regarded as typical, we have the posterior and inferior molars, and even the premolars of the same genus described under separate generic names. In his first contribution nine generic names may be, with the greatest probability, referred to two genera. One of these is the genus Meniscoëssus, known since 1882, and the other is not shown to be distinct from Chirox or Polymastodon of the Puerco fauna. Of Bunotheria the three genera are proposed on teeth from different positions in the jaws of forms which may well belong to one genus, and no evidence is brought forward to show how they differ generically from the smaller species of Sarcothraustes of the Puerco. This is not the way to advance science.

Professor Marsh states that the genus Meniscoëssus was described from a tooth which he supposes to belong to a reptile. The fact is that was founded on the molar tooth of the mammal to which Professor Marsh now gives, among others, the name Selenacodon. (See AMERICAN NATURALIST, 1882, p. 830.)—*E. D. Cope.*

NOTES ON THE ORIGIN AND HISTORY OF THE GREAT LAKES OF NORTH AMERICA.[1]—*Discovery of the ancient course of the St. Lawrence River.* Previous investigations by the author showed that there was a former river draining the Erie basin and flowing into the extreme western end of Lake On-

[1] Abstract from the Proceedings of the American Association for the Advancement of Science, vol. xxxvii.

tario, and thence to the east of Oswego, but no further traceable, as the lake bottom rose to the northeast. Upon the southern side there was a series of escarpments (some now submerged), with vertical cliffs facing the old channel. By recent studies of the elevated beaches, it is demonstrated that the disappearance of this valley is due to subsequent warpings of the earth's crust, and that the valley of the St. Lawrence was one with that of Lake Ontario. Recent discoveries of a deep channel upon the northern side of Lake Ontario (a few miles east of Toronto), and of the absence of rocks to a great depth under the drift, far beneath the surface of Lake Huron, between Lake Ontario and the Georgian Bay—and in front of the Niagara escarpment, between these lakes—of a channel in Georgia Bay, at the foot of the escarpment, and of the channel across Lake Huron, also at the foot of a high submerged escarpment, show that the ancient St. Lawrence, during a period of high continental elevation, rose in Lake Michigan, flowed across Lake Huron, and down Georgian Bay and a channel, now filled with drift, to Lake Ontario; thence by the present St. Lawrence valley to the sea, receiving on its way the ancient drainage of the Erie basin and other valleys.

Origin of the basins of the Great Lakes. The two questions involved are the "origin of the valleys" and the "cause of their being closed into water basins." The basins of Lakes Ontario and Huron are taken for consideration. The previous paper, upon the course of the ancient St. Lawrence, shows that the Huron and Ontario basins are sections of the former great St. Lawrence valley, which was bounded, especially upon the southern side, by high and precipitous escarpments, some of which are submerged. Upon its northern side there were lesser vertical escarpments, now submerged, with walls facing the old valley. The valley was excavated when the continent was at a high altitude, for the eastern portion stood at least 1,200 feet higher than at present, as shown by the channels in the Lower St. Lawrence, in Hudson's Straits, and off the New York and Chesapeake Bays. The valley was obstructed in part by drift and in part by a north and northeastward differential elevation of the earth's surface, due to terrestrial movements. The measurable amount of warping defied investigation until recently, but it is now measured by the uplift of the beaches and sea cliffs. Only one other explanation of the origin of the basins need be considered—that of the "Erosion by Glaciers," (*a*) because the lake basins occur in glaciated regions; (*b*) glaciers are considered (by some) to erode; (*c*) supposed necessity, as the terrestrial warping was not known.

In reply: Living glaciers abrade but do not erode hard rocks, and both modern and extinct glaciers are known to have flowed over even loose moraines and gravels. Again, even although glaciers were capable of great plowing action, they did not affect the lake valleys, as the glaciation of the surface rocks shows the movement to have been at angles (from 15° to 90°) to the trend of the vertical escarpments against which the movement occurred. Also, the vertical faces of the escarpments are not smoothed off, as are the faces of the Alpine valleys down which the glaciers have passed. Lastly, the warping of the earth's surface in the lake region since the beach episode, after the deposit of the drift proper, is nearly enough to account for all rocky barriers which obstruct the old valley and form lake basins.

Establishment and dismemberment of Lake Warren. This is the first chapter in the history of the Great Lakes, and is subsequent to the deposit of the upper boulder clay, and therefore the lakes are all very new in point of geological time. By the warping movements of the earth's crust, as shown in the beaches—after the deposit of the later boulder clay—the lake region was reduced to sea level,and there were no Canadian highlands northward of the Great Lakes. During the subsequent elevations of the continent beaches were made around the rising islands. Thus, between Lakes Erie, Huron and Ontario a true beach was formed at 1,690 feet above the sea around a small island rising 30 feet higher. With the rising of the continent, Lake (or perhaps Gulf of) Warren—a name given to the sheet of water covering the basin of all the Great Lakes—was formed. A succession of beaches of this lake have been worked out in Canada, and from Lake Michigan to New York, extending over many hundreds—almost thousands—of miles. Everywhere the differential uplift has increased from almost zero, about the western end of the Erie basin, to three, five, and, in the higher beaches, more feet per mile. With the successive elevations of the land this lake became dismembered, as described in the succeeding papers, and the present lakes had their birth. The idea that these beaches in Ohio and Michigan were held in by glacial dams to the northward is disproven by the occurrence of open water and beaches to the north, which belong to the same series, and by the fact that outlets existed where glacial dams would be required.

Discovery of the outlet of Huron-Michigan-Superior Lake into Lake Ontario, by the Trent Valley. With the continental elevation described in the last paper—owing to the land rising more rapidly to the northeast—Lake Warren became

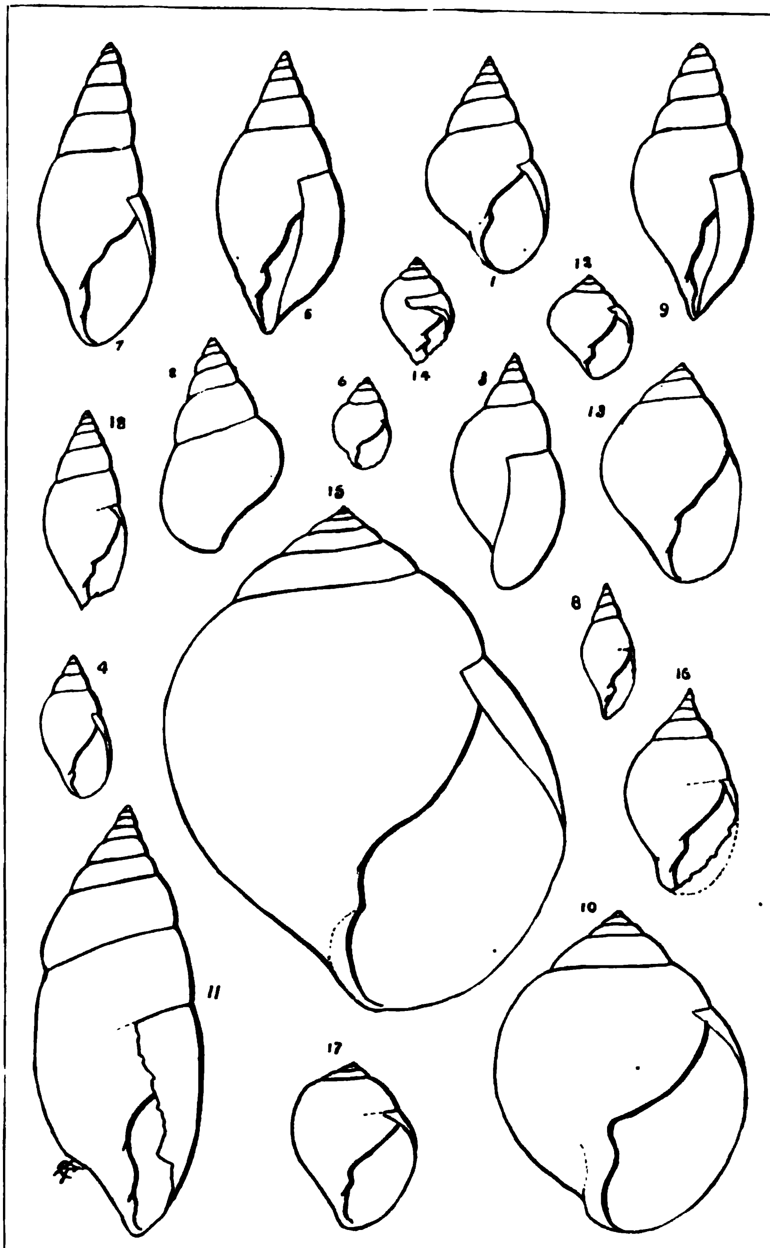
dismembered, and Huron, Michigan and Superior formed one lake; the Erie basin was lifted out of the bed of Lake Warren and became drained, and Ontario remained a lake at a lower level. The outlet of the upper lake was southeast of Georgian Bay by way of the Trent valley into Lake Ontario, at about sixty miles west of the present outlet of this lake. The outlet of this upper lake was 26 feet deep where it connected with the Trent valley, and the channel was from one to two miles wide. This, for a few miles, is cut across a drift ridge to a depth of 500 feet. With the continued continental uplift to the northeast (which has raised the old beach at the outlet into the Trent valley, about 300 feet above the present surface of Lake Huron), the waters were backed southward and overflowed into the Erie basin, thus making the Erie outlet of the upper lakes to be of recent date. This is proven by the fact that the beach which marked the old surface plain of the upper Great Lake descends to the present water level at the southern end of Lake Huron.

Erie the youngest of all the Great Lakes. The Erie basin is very shallow, and upon the dismemberment of Lake Warren was drained by the newly constructed Niagara River (except, perhaps, a small lakelet southeast of Long Point). Subsequently the northeastward warping (very much less in amount than farther northward at the Trent outlet) eventually lifted up a rocky barrier and formed Erie into a lake in recent times, thus making Erie the youngest of all the lakes. The beaches about Cleveland are not those of separated Lake Erie, but belong to the older and original Lake Warren.

[NOTE.—To distinguish from the modern, the ancient valley of the St. Lawrence, above described, is named the "Laurentian," the ancient river from the Erie basin the Erigan, the Huron-Michigan-Superior Lake the Algonquin, as also the beach which marked its shores and the river which discharged its waters by the Trent valley. The expanded, but separate, Lake Ontario is named the Iroquois, as also its principal beach, now at 116 feet above its modern surface at the extreme western end of the lake, while at about 135 miles northeastward (near Trenton) its elevation is 435 feet.—*J. W. Spencer*, University of Georgia, Athens, Ga.]

KRAKATOA.—A period of five years has not been found too long in which to collect and collate the material necessary for a history of the gigantic eruption of 1883, which has been

PLATE XX.



Soleniscus.

made the subject of elaborate Reports by Dutch, German and English investigators.[1]

These Reports have been recently published and have been ably reviewed in recent issues of the *Contemporary* and *Edinburgh Reviews*.[2]

For a description of the physical characteristics of the great eruption the reader may consult these publications, but the scientific results as detailed in the several Reports may be briefly summarized. The process by which the eruption was brought about is considered to be typical of the physical action of volcanoes all over the world. Sea and surface water obtain access to the vent or to the heated rocks below it, and if brought suddenly into contact may give rise, by the development of steam, to earthquakes or eruptions of moderate strength, but it is to the slow percolation of water into rocks in a certain condition that the author of the English Report attributes the principal part in cataclysmal outbreaks. The water combines with the material of the rock, and by this combination the melting point of the rock is reduced; it only requires the subjection of the hydrated compound to such heat as would be supplied by the anhydrous lavas in a fluid condition to disengage steam and other gases in enormous quanities, and to produce outbursts proportionate to the pressure and the strength of the inclosing walls. If, while this process is going on; water in large quanities gains access to the surface of the heated mass, solidification might take place and the escape of gases through the crater would be temporarily checked. When at last the accumulated force bursts the newly-formed crust, this and other obstacles would be speedily removed by the tremendous violence of the blast, and the sides of the crater might either be blown away or fall into the seething lava. Such appears to have been the working of the final eruption of Krakatoa. The objection that water could not percolate to great depths, owing to the upward pressure of steam, already

[1] Krakatau. Par. M. Berbeck. Publié par ordre de Son Excellence le Gouverneur Général des Indes Néderlandaises. Batavia: 1884 and 1885. Paris; 1885 and 1886.

The Eruption of Krakatoa and Subsequent Phenomena. Report of a Committee appointed by the Royal Society 1888.

Untersuchungen über Dammerungserscheinungen zur Erklärung der nach dem Krakatau-Ausbruch beobachteten atmosphärisch-optischen Störung. Von J. Kiessling. Hamburg and Leipzig: 1888.

[2] *Contemporary Review*, November, 1888. New York; Leonard Scott Publishing Company.

Edinburgh Review, January, 1889. New York; Leonard Scott Publishing Co.

formed, is met by recent experiments which show that the capillary action continues in spite of such pressure.

The presence of volcanic cones and craters on the moon would seem to invalidate the "steam engine" theory as well as the hydrated lava theory of Professor Judd, unless the presence of water in large bodies is admitted, On both the earth and moon the expansion of fluid rock in the process of cooling would bring to bear an enormous pressure, resulting in outwellings of lava, and violent eruptions would be accounted for by the development of steam on a large scale. It is generally admitted that communication exists not unfrequently between reservoirs of molten rock at great distances from each other on lines of fissure. Heated rocks, subjected to the hydration and aeration of infiltrated water would probably occupy more space in a solid than in a pasty or liquid condition, and would melt at a lower temperature. Contraction by cooling of the solidified part of the globe, works in the opposite direction; but while this process is fairly regular and even, solidification may take place unequally, rapidly, and by local causes, such as cooling by extensive aqueous percolation. Other causes of periodic increases of pressure would be the shrinkage of the earth's crust upon the cooling interior, the percolation of water through fissures and the closure of these fissures by changes of level, so that steam developed at some miles below the surface would force the fluid lava through the nearest volcanic vent. As far as the argument from the moon is concerned, it can be readily disposed of by admitting the previous existence of water on its surface, which has been entirely absorbed by the rocky substance.

Among the attendant phenomena of the eruptions were the sea-waves. These caused greater destruction both to property and to human life than any other of the attendant phenomena. They are treated at great length by Captain Wharton in the English Report. Undulations were produced reaching as far as Havre, a distance of 10,780 miles from the original source of disturbance. The seismic flows and ebbs which thus covered a very large part of the globe were composed of long undulations, with periods of over an hour, and of shorter superposed irregular waves at brief intervals. The rate of propagation was in all cases less than theory would demand for the supposed depth of water. The average speed seems to have been something between 330 and 380 miles per hour. The mean depths deduced by the usual formula from this speed are less than those given by actual soundings. The cause of this discrepancy

is not clear; but if the tide gauges can be relied upon, and the disturbances recorded are due to identical original waves, it seems probable that submarine elevations and ridges, hitherto unknown, retard the progress of the disturbance. The period of the long wave was originally about two hours, but at distant stations, such as Orange Bay and the ports of the English Channel, the period seems to have been reduced to about one fourth, and, throughout the course of the undulations, its original character appears to have undergone considerable modification. The cause of an undulation with a period of two hours remains a mystery, but of the correspondence between the water and air waves in point of time at starting there can be no question. An upheaval of the sea bottom must have been very slow to account for the length of the wave; no earthquake was observed, and the evidence generally is against earth disturbance as a cause. It is noted that the bulk of the fragments thrown out during the explosions must have fallen into the sea, and by their impact, almost coinciding with the violent evisceration of the crater, must have contributed to the rush of the destructive waves, and Captain Wharton calculates that a fiftieth part of the missing mass of Krakatoa, which was estimated to be at least 200,000,000,000 cubic feet, would, by dropping suddenly into the water, form a wave circle of 100 miles in circumference, 20 feet high, and 350 feet wide. But this is inadequate to account for the long wave; and he therefore holds that the destructive waves in the Strait of Sunda were mainly due to masses falling into the sea, or to sudden explosions under the sea, but that the long wave recorded by distant tide guages had its origin in upheaval of the bottom.

Another marked accompaniment of the explosion was the air wave. Reports from 47 stations representing the entire civilized world show that an air wave spread out from Krakatoa as a centre expanding in a circular form till half round the globe, concentrated again towards the Antipodes, whence it started afresh and travelled back to Krakatoa, occupying in the double journey 36 hours, rebounded and set off again on the same revolution, and repeated the movement at least three times sufficiently strongly to be recorded. Seven passages, going and returning were indicated by the diagrams at some stations. The whole process was almost exactly similar to the alternate expansions and contractions of a wave of water caused by dropping a stone at the centre of a circular pool. The barograms give tidings of atmospheric movements comparable to gigantic waves of sound, starting from a small area

and encompassing the globe, several times in succession, completing each circuit in about 36 hours. The mean speed of propagation was about 700 miles an hour, less by 23 miles than the velocity of sound at zero Fahrenheit; the velocity, in fact, seems to have corresponded to that of sound in air at 20 or 30 degrees below zero.

Among other interesting observations noted in connection with this eruption are those relating to the propagation of sound. Authentic instances are recorded of sounds caused by the explosions being heard at distances of 1210, 1902, 2014, 2267, and 2968 miles, being quite the longest distances that sound has been known to travel. The English Report includes a number of interesting and instructive hypotheses. The concensus of opinion as to the red sunsets which formed so conspicuous a feature of the autumn evenings of 1883 is that they may be traced to Krakatoa. The general conclusions are admirably traced by Sir Robert Ball:

First of all it would be natural to ask whether the existence of volcanic dust in the air could have produced the optical effects that have been observed. This must be answered in the affirmative. Then it would be proper to inquire whether other volcanic outbreaks in other parts of the world, and on other occasions, had been known to have been followed by similar results. Here, again, we have page after page of carefully stated and striking facts which answer this question also in the affirmative. Next it would be right to see whether the sequence in which the phenomena were produced at different places in the autumn of 1883, tallied with the supposition that they all diverged from Krakatoa. The instances that could be produced in support of the affirmative number many hundreds, though it must be admitted that there are some few cases about which there are difficulties. Surely we have here what is practically a demonstration. It is certain that these optical phenomena existed. No cause can be assigned for them except the presence, at that particular time, of vast volumes of dust in the air. What brought that dust into the air except the explosion of Krakatoa? Most people find themselves unable to share the scruples of those who think there can be a doubt on the matter. Would another eruption of Krakatoa, followed by a repitition of all the optical phenomena, convince them that in this case, at all events, *post hoc* was *propter hoc*. Perhaps not, if they have already failed in being convinced by the fact that, when Krakatoa exploded two centuries ago, blood red skies appear to have been seen shortly afterwards as far away as Denmark.

ZOOLOGY.

UNSEASONABLE VISITORS.—Monmouth County, New Jersey, has had an open Winter, and with it some interesting phenomena. Among the fishing industries, crabbing is one, of which there are two seasons—the special and the general, the former being when the crabs are shedding their shells, and are known as shedders or soft-shells. In this condition they are considered a great luxury, and bring the highest prices. But the soft-shells only have a short season. The hard shells continue the year through, except in the winter, when they betake themselves to the mud. A shrewd fisherman found out that the crabs this Winter in Raritan Bay had not taken to the mud; so he continued to catch them, and owing to their good condition, and the unusual fact of getting them in the Winter, he got good prices. It was in vain that the man tried to keep his secret. It leaked out, and there was a rush which soon closed the business.

The common eel, also, in the Winter, hides in the mud; but the fishermen have continued to catch them in these parts this Winter.

In February, some men while clearing pine land with the grubbing hoe, at a depth of five or six inches, unearthed a nest of snapping turtles—*Chelydra serpentina*. There were four young ones, just out of their shells, the latter lying in the nest. They were soft, though frozen stiff. One told the other to handle them carefully, or the legs would break off. Taken to the house they soon thawed, and became very lively, but being kept through the night in a room without fire, they succumbed to the cold, and died. As these young reptiles usually do not appear until Summer, I was a little puzzled at this premature hatching. The fact too, that they could not endure the cold, after being once warmed, should have some significance.

About the middle of March we had our only real snowstorm, the fall being some six inches. It only lasted three or four days, but ere it had quite gone four snakes came out of the ground at Keyport. They varied in length from sixteen inches to two feet, and formed one company. My informant told me that he "went for them," but that the two largest got away into the bushes. From his description it is probable that they were garter snakes, but however innocent, or even useful, a

snake in the popular creed is "a varmint with no right to live."

On the 22d of March a fine male specimen of the giant bug, *Belostoma grandis*, was also caught in Keyport. The *quid nuncs* of the town were greatly exercised over the "huge cockroach!" One man, however, who "knew it all," said he had "lots of them roaches, only not nigh so big, in their kitchen." In my experience, this is a very untimely occurence of this fine insect, and the specimen was in excellent condition. The bug is bred in the water, issuing thence in the imago state generally in the Summer, and flying in the night. I have received a number of specimens from Asbury Park, and Trenton, which had been killed by dashing against the electric lamps. —*Samuel Lockwood.*

THE POISONOUS ARACHNIDA OF RUSSIA.—At a recent meeting of the Dorpat Naturalists' Society, Professor Kobert spoke of the reputedly poisonous spiders of Russia. According to the observations of Dr. Walter, of Jena, *Galeodes araneoides* is not poisonous, and does not even possess poison-glands. *Trophosa singoriensis*, the Russian Tarantula, is not poisonous to warm blooded animals, although it is to lower animals. In the case of *Latrodectes* 13-*guttatus* not only the poison-glands but all parts of the body contain an unformed protoplasmic poisonous ferment, which has much the same physiological effect when injected into the circulation as cyanic acid and strychnine.

NEW ORGANS IN THE COCKROACH.—Mr. Edward A. Minchin describes (*Quar. Jour. Micros. Sci.*, December, 1888) an ectodermal organ in the cockroach, which may possibly be a stink-gland. It consists of a pair of involutions of the cuticle on the dorsal surface of the abdomen, between the fifth and sixth segments, and opening by means of two slits near the median line, which are usually covered by the posterior margin of the fifth segment. Internally each pouch is lined by a chiterious cuticle, bearing numerous branched hairs, and beneath them glandular epithelial cells.

ZOOLOGICAL NEWS—MOLLUSCA.—J. I. Peck (*J. H. U. Circ.*, No. 70) describes the anatomy of the Pteropod *Cymbulopsis calceola*, which he studied by means of serial sections.

In the same place, Mr. S. Watase records a remarkable phenomenon in the segmentation of the egg of *Loligo pealii.* He

was successful in artificial impregnation and in tracing the histories of the various segmentation planes. The first plane is longitudinal, and for many stages an alternation of rest and activity on the opposite sides of this plane is noticeable. Thus at one time almost every nucleus on the left side shows distinct mitosis figures, while not a single nucleus of the right side exhibits such a feature. This was witnessed again and again, until the blastoderm contained 116 cells.

CRUSTACEA.—Professors W. K. Brooks and F. H. Herrick describe (*J. H. U. Circ.*, No. 70) some features in the development of the Peneid form *Sergestes hispidus*. It escapes from the egg as a protozoea, passes soon to the true zoea stage, and then to a mastigopus condition.

GENERAL.—Dr. H. V. Wilson gives an account (*J. H. U. Circ.*, No. 70) of the times of breeding of several marine forms at the Bahamas, which will prove of value to students visiting the West Indies.

WORMS.—Dr. Hurst records (*Notes from Leyden Museum*, January, 1889) the presence of *Arenicola cristata* (originally described by Stimpson from South Carolina) at Naples.

EMBRYOLOGY.

THE ORIGIN AND MEANING OF SEX.[1]—My hypothesis respecting the origin and meaning of sex may be stated provisionally as follows, pending a fuller sketch to be published in the immediate future.

1. Over-nutrition is regarded as the prime cause of the un-

[1] Seventeen paragraphs, or those numbered 1, 2, 8, 9, 12 to 18, 21, 22, and 25 to 28, of this article comprise all except 154 words, *verbatim et literatim*, of the first draft of a synopsis of the hypothesis here somewhat more fully presented. The Secretary of the Academy of Natural Sciences, of Philadelphia, advised the withdrawal of that first draft, which was offered for their *Proceedings*, on the ground that it was unwarrantably anticipated by the publication of the same matter in a supplementary notice, which was privately published by the author, with the same title, dated July 5, 1889, and which also forms part of the present article. This note is neccessary in order to correct any possible erroneous impression which may have arisen in the minds of those to whom copies of extras were sent of the first article, as to the latter's source, as it was printed, in advance of the issue of the signatures of the Academy's *Proceedings*, and bore the imprint of the latter.

equal growth of cells, or of individuals, if the latter are unicellular.

2. The differentiation of sexuality as a result of such unequal nutrition, through which a difference in potential of segmentational power was developed in consequence of physiological differentiation, accompanied by a great difference in size.

3. Over-nutrition in animals and plants has led to all the forms of sexual, asexual, and parthenogenetic reproduction.

4. The over-nutrition of ova, ovules, etc., through which they have grown beyond the average size of the other cells of the body of the parent, is proof that they have in some way lost the power to undergo spontaneous segmentation, except in the case of parthenogenesis, which will be dealt with more fully hereafter.

5. Over-nutrition of the male mother-cells, accompanied by an exaltation of segmentational power, has caused their products to become the smallest cells produced by the body, with a concomitant augmentation of latent segmentational power.

6. Ovum and spermatozoon are not homologous, but only sperm-mother-cells or groups of them and ova are homologous; the same law applies to the germ-cells of plants.

7. The production of the definitive sexual elements of the multicellular forms has proceeded *pari passu* with an extreme physiological differentiation of karyokinetic function in the two kinds, which stand in a reciprocal relation to each other, and which has been the cause of their reciprocal attraction for each other, leading to the act of fertilization.

8. The ability of such over-nourished cells to go on segmenting only as result of the union of such pairs of unequal dimensions, which stand to each other in a reciprocal relation of potentiality as respects segmentational power. The female cell has lost the power to spontaneously segment, whereas the male cell has acquired an exaltation of latent segmentational power.

9. The integration of such large masses of living matter as single units made it possible for the results of such segmentations to cohere, instead of falling apart. If, in fact, such prepatory accumulation of material had not occurred, rapid, simultaneous and successive segmentations would have been impossible, since *pari passu* with the differentiation of their segmentational function such germ-cells finally lose *in toto* the power to nourish themselves except when in a relation of continuity with the parent organism.

10. The aggregation of large masses of segmentable plasma has also enabled the products of such simultaneous and successive segmentations to cohere and remain a multicellular aggregate, and to thus lay the foundations and become the direct cause of all metazoan and metaphytic organization.

11. The over-nutrition of the female element and the augmentation of its mass has rendered possible complex series of simultaneous and successive segmentations, in planes of from one to three dimensions, and the development of embryos without need of other nutriment during the preliminary or larval stages of ontogeny, thus leading also to the evolution of all larval forms.

12. So long as living organisms remained unicellular they were enabled to vary and become adapted only within the narrow limits determined by their unicellular condition, yet we know how marked is variability, even in this low grade of development; proportionally far greater than in multicellular types.

13. The achievement of the multicellular condition, as I have supposed, produced new and more complex morphological relations leading to the manifold differentiation of physiological functions in relation to diversification of surroundings, thus introducing a new and most powerful cause or capacity for variations and adaptations under such diverse conditions.

14. It is thus seen that the evolution of sexuality is the indirect cause of variability, and that otherwise there could have been no such thing as a struggle for existence leading to natural selection amongst multicellular organisms—at least seeing that they must have been produced, according to this hypothesis, as a result of the development of sexuality.

15. Over-nourishment in the vegetable, then lead to the over-nourishment of the animal world and the over-production of germs or young in both, so that the rate of increase became augmented in a geometrical ratio, as supposed upon the Darwinian hypothesis, which, on the basis of the theory of the struggle for existence and the process of natural selection so evoked, accounts for the preservation of valuable or advantageous variations through survival and inheritance.

16. Over-nourishment, then, is, according to the present hypothesis, regarded as the primary caûse of morphological differentiation under the stress of diverse conditions, as well as of the geometrical ratio of increase of such forms, and, consequently, of the struggle for existence.

17. The doctrine of over-nutrition consequently becomes

antecedent to that of Darwinism, since it accounts for the primary diversification of species on the basis of inequalities of cell-nutrition in all forms, thus seizing upon the diversification of the physiological powers of the primal forms of life as the first factors in biological evolution, and which gave the latter its first impulse and upon which all further impulses have been superimposed.

18. Sexuality is thus rendered the motive force of all biological development, but in a totally different sense from that hitherto held by any one else.

19. While sexuality thus viewed becomes the motive force of all biological evolution it also gives rise to the means of variability and a greatly augmented fertility of individuals, thus also leading to the struggle for existence and natural selection.

20. Sexuality is therefore found to transcend in importance the principle of natural selection itself, since over-nutrition only could have led to the over-production of germs and the consequent increase of individuals in a geometrical ratio, as assumed by the Darwinian hypothesis, and, since the vegetable world stands in an annectant relation between the not-living and animal world, it can be understood how the latter came to be over-nourished.

21. This hypothesis further assumes that, with the gradual circumscription and localization within more and more restricted limits, of the production of germ-cells, and *pari passu* with morphological differentiation, that the reproductive and recapitulative powers of the other cells of multicellular organisms became gradually less and less marked, owing to the gradually more intensified expression of the principle of the physiological division of labor in the evolution of organs with more and more definite functions.

22. It regards the hypothesis of the immortality and immutability of the *Keimplasma* as inadequate, and as absolutely disproved by the facts of morphological development alone.

23. The production of germ-cells has been localized more and more definitely as a result of the increasing morphological specialization of multicellular forms, so that the the hypothesis which assumes that the germ-plasma is precociously set aside in order to render it unmiscible with the somatic plasma, and therefore immortal, is based upon a fundamental error of interpretation of the facts of morphology.

24. The only cells in the multicellular forms which are ab-

solutely otherwise functionless are the germ-cells. They alone, therefore, can become the vehicles for the transmission of all the traits of the parent in higher forms, since they alone are otherwise functionally unoccupied, and are the only cells of the body which, by any stretch of the imagination, can be supposed, *a priori*, to possess the recapitulative power manifested in ontogeny.

25. It further assumes that the theory of the geometrical ratio of increase is qualified by the advent of multicellular forms as a direct result of the development of sexuality, and that, reckoning on the basis of cell generations, the ratio of increase in the animal and plant world is absolutely and relatively less than if living forms had remained unicellular.

26. It leads also to the assumption that biological evolution has been along definite lines, and not fortuitous or hap-hazard, as has been tacitly or avowedly assumed by some incautious but extreme partisans of the doctrine of natural selection.

27. This hypothesis is based on the assumption that the undifferentiated nucleated cell is the point of departure for all morphological and physiological differentiation, and that the first depends upon the character of the karyokinetic changes which go on within it, while the second depends upon the nature of its metabolism and the mechanical arrangement and constitution of the plasma through which such metabolism is manifested.

28. Upon this ground may be based a further development of hypothesis which gives a satisfactory explanation of parthenogenesis, pædogenesis, gemmation, temnogeny, metagenesis, and the recapitulative processes of ordinary sexual genesis.

29. In the production of female germs (ova, oospheres,) there occurs a prolonged process of intergration of plasma to increase the volume of the cell-body. In the production of male elements, (spermatozoa, antherozoids,) on the contrary, an actual process of elimination of plasma occurs, so as to reduce the cell-body to a minimum size and leave little remaining except the nucleus and its chromatin. The modes of production of the male and female elements therefore, stand in the most extreme contrast in respect to each other.

This hypothesis, founded upon data which have been hitherto apparently ignored, applies to both the animal and vegetable kingdoms, sex having probably arisen simultaneously

and independently in both, as soon as certain cells of coherent groups become over-nourished and incapable of further segmentation unless brought into contact and fused with the minute male elements, or one which, as we have seen, is the product of an exalted segmentational power which is transferred to the female element in the act of fertilization. Both kinds of sexual products were probably at first, and still continue to be, dehisced from the parent organisms as useless products of over-nutrition, after further recapitulative growth in the form of new axes or of individuals, growing in organic union, as in colonial organisms, became impossible, due to crowding, the culmination of seasonal growth or the morphological specialization leading to definite or constant formal individuality.

All the facts which I have been able to gather lead to the conclusion that there is a relation between the difference in size of the male and female elements as to the number and rapidity of the subsequent segmentations of the resulting oösperm or oösphere. If the elements are alike there will be comparatively few segmentations; if greatly unlike, many successive segmentations seem possible.

The foregoing hypothesis affords clews to the reasons for variations in the fertility of species, the origin of viviparity and placentation, the infertility of irrelated forms, the origin of food yolk in ova and of pelagic eggs, the evolution of primary and secondary sexual characters, the interrelations of plants and animals, and a consistent and simple theory of inheritance, which is in harmony with all the facts of reproduction in plants and animals.

This hypothesis also discloses some of the apparent reasons why there is so frequently a great difference in the size of the sexes, as in fishes, where the male is smallest, and especially in those arthropodous forms, in which the males are microscopic and attached to or parasitic on the females, as in some Copepoda and Cirripedia. The extraordinary feeding and nursing habits of social Hymenoptera, efficient in determining the sex or neutrality of offspring, also acquire a new significance.

The first steps by which the over-growth of the sexual elements through over-nourishment is seen in the most primitive of all known non-parasitic, free-swimming, multicellular forms, namely, *Volvox*. Its life history proves that the multicellular condition can be, and probably was, attained directly by the over-growth and subsequent segmentation of a single cell in

three planes, simultaneously and successively, with but little coherence, forming a delicate blastula, the cells of which are separated from each other by interspaces, and joined together by very slender protoplasmic bonds. Certain cells of this blastula-like organism grow directly into germs with exaggerated dimensions. The wall of the *Volvox* blastula is probably ectodermic and entodermic in its homologies, gastrulation is still to occur, but it is interesting to observe that already the germs are produced in a little more than one hemisphere only, which probably corresponds to the ectodermic portion of a Cœlenterate, while the empty, anterior, directive, and sensory pole is homologous with the entoderm of the latter. The tendency of the germ-cells to originate from the ectoderm in some Cœlenerates, therefore, may have an ancestral significance.

The over-growth of Protozoan or Protistan forms probably gave rise, through a series of segmentations, directly to such types as *Volvox*, and simulating the planula or blastula more or less closely. Gastrulation, under its various guises, as well as proliferation and delamination, also followed, with their consequences, which led to the direct development of the various forms of ciliated larvæ, at once ready to feed, undergo metamorphoses, and share in the struggle for existence.

This first larval development was probably rapid, and due to the same causes as are still seen to be operative in the development of ova, namely, rapid segmentation. The accumulation in the egg of a mass of plasma in excess of the average of its fellow cells or individuals, laid the foundation for the first and most primitive type of segmentation, namely, the holoblastic, before any yolk was added to the ovum, as is seen in the development of *Volvox*. This coherent aggregate was now an individual, ready to begin the struggle for existence, and with infinite capacity for variation, and with an augmented power of reproduction.

The ovum, according to this hypothesis, becomes the conservative factor in biological evolution in a new sense, while the male element imparts the power to undergo rapid segmentation, and to quickly achieve the larval state, when the interaction of the organism and the environment can be brought into play. The physiological activities of such plasmic aggregates as an oösperm are at first almost wholly karyokinetic, and but slightly metabolic; this renders possible the later and immediately subsequent anabolism through which further growth and

power is acquired. In the vegetable world there has, from the first, been a tendency to form plates, filaments, and later columns of cell aggregates, instead of the blastula form of animal types. Sexuality, or the development of male and female elements, therefore, has a meaning, fraught with consequences and promises which have culminated in the most wonderful morphological and adaptive specialization, and probably in definite ways, which might have been predicted had all the conditions been known.

N. B.—Finally, it is necessary to point out here that these views have little in common with those urged by Geddes. While a preponderance of anabolic activity may produce an ovum, as he supposes, how it is possible to conceive that processes of physiological disintegration or katabolism, such as are witnessed in the breaking down of protoplasm into simpler compounds, could result in the production of male-cells, I utterly fail to comprehend. That growth is accompanied by katabolism there is no doubt, but to assume that the tremendous energy with which karyokinesis manifests itself in spermatogenesis is merely an exhibition of preponderent katabolism, which must result in the enfeeblement of the cells so produced, stands in such obvious contradiction to all that we know of the male-cells, that such an erroneous view must be unhesitatingly pronounced inadequate and unfounded. Anabolism and katabolism, or the molecular processes by which protoplasm is built up and torn down, cannot be tortured into an equivalency with the widely diverse modes of manifestation of karyokinetic activity in the morphologically homologous ovum and sperm mother-cells.

The fundamental error lies in confounding ordinary physiological processes with special modes of the manifestation of karyokinesis, and since there is no other known instance of katabolism resulting in the breaking up of cells by rapid cleavage into small cells, such as those produced from spermoblasts, it may well be doubted if the equivalency sought to be established is anything more than fanciful. —*John A. Ryder.*

PHYSIOLOGY.[1]

GASKELL'S WORK.—The most important recent work on the physiology of peripheral nerves, is that of Dr. W. H. Gaskell, of Cambridge, which has occupied him during the past ten years.[2] Begun as a contribution to cardiac physiology, it has extended itself much beyond this, and bids fair to alter fundamentally our conceptions of the morphological and

[1] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] Gaskell's chief articles are published as follows—
Phil. Trans. 1882. p. 993.
Journal of Physiology. Vol. IV. p. 43.
" " Vol. V. p. 362.
" " Vol. VII. p. 1.
Medico-Chirurgical Transactions. Vol. LXXI. (Contains a summary of results up to the receipt of the Marshall Hall Prize.)
Journal of Physiology. Vol. X. p. 153.

physiological natures of peripheral nerves. For this work the author received last year the Marshall Hall prize. An abstract of the results follows.

Gaskell began his work by the study of the innervation of the frog's heart. He found that the vagus not only inhibits but also accelerates the rate of the contractions. This led to the discovery that the vagus in the frog is in reality the vago-sympathetic, *i. e.* the nerve trunk consists in part of vagus fibres, in part of sympathetic fibres, the two uniting early in their course; the vagus fibres proper are inhibitory, the sympathetic fibres cause acceleration. Taking into account not only the primary effects of the stimulation of these fibres, but also the after effects, Gaskell came to the conclusion that "the process of inhibition is bound up with changes in the muscle of a beneficial nature to the further action of that muscle, while the action of the augmentor nerve resembles rather the action of a motor nerve, and causes an exhaustion of the muscular activity." He concluded, therefore, that "inhibition of contraction is the symptom of the action of an *anabolic* nerve *i. e.* a nerve which brings about constructive metabolism, just as much as contraction or augmentation of contraction is the symptom of the action of a *katabolic* nerve *i. e.* a nerve which causes a destructive metabolism." He further studied the nerve supply of the rest of the vascular system, and came to the conclusion that all tissues are supplied with two sets of nerve fibres, one anabolic in nature, the other katabolic.

In the study of the nerves of the tortoise's heart, he found that the sympathetic, or katabolic, fibres were all non-medullated, while the vagus, or anabolic, fibres were medullated. So here was a morphological difference bound up with a physiological difference, and the question arose, does this distinction hold good throughout the entire course.

The efferent nerves of the body can be divided into groups according to their function. If this division be not purely artificial, the members of the different groups should agree with one another morphologically as well as physiologically. Gaskell made the following classification of efferent nerves, and studied the different groups with great care.

EFFERENT NERVES:

1. Nerves of the vascular muscles.
   (a) Vaso-motor, *i. e.* vaso-constrictors, accelerators and augmentors of the heart.

(b) Vaso-inhibitory, *i. e.* vaso-dilators and inhibitors of the heart.

2. Nerves of the visceral muscles.
   (a) Viscero-motor.
   (b) Viscero-inhibitory.
3. Glandular nerves.

He found that the "vaso-motor nerves for all parts of the body can be traced as bundles of the finest medullated fibres in the anterior roots of all the spinal nerves between the 10th and 25th, inclusive, along the corresponding *ramus visceralis* (white *ramus communicans*) to the ganglia of the lateral chain (main sympathetic chain) where they become non-medullated and are thence distributed to their destination either directly or after communication with other ganglia." The viscero-motor nerves are also fine medullated fibres which become non-medullated in the chain of sympathetic ganglia. As to the vaso-inhibitory fibres, these too start from the spinal cord as fine medullated fibres, becoming non-medullated in the collateral or terminal ganglia; the difference between the vaso-motor and vaso-inhibitory fibres lies therefore in the place where they lose their medulla, the former becoming non-medullated in the proximal ganglia, the latter in the distal ganglia. The viscero-inhibitory fibres agree with the vaso inhibitory just as the viscero-motor agree with the vaso-motor. The conclusion arrived at from this work is that "the vascular and visceral muscles are throughout supplied by two kinds of nerve fibres of opposite function, the one motor and the other inhibitory; and that further these two kinds of nerve fibres reach the muscle by separate, distinct anatomical paths, the difference of path consisting in a difference of origin from the central nervous system combined with the fact that the inhibitory nerves lose their medulla in more distant ganglia than the corresponding motor nerves." Moreover, the investigation of the course of the efferent nerves led Gaskell to regard the sympathetic and homologous ganglia as the motor or efferent ganglia of these visceral fibres; so that instead of the old conception of two nervous systems which interchange fibres with each other, he would substitute the following definition of the nerve belonging to a spinal segment— "A spinal nerve is composed of anterior and posterior roots both ganglionated, the ganglion of the afferent root always being stationary, while that of the efferent root is vagrant and has traveled away to various distances from the central nervous system,"

these vagrant ganglia being the ganglia of the sympathetic system.

The results of Gaskell's latest work concern the relation between the spinal and cranial nerves. In order to make a comparison between these two, it is necessary to have a clear idea of a complete spinal nerve. According to Gaskell such a nerve consists of— 1. A posterior root composed of afferent fibres, both somatic and splanchnic, the ganglion of which root is stationary in position, and is always situated near the entrance of the fibres into the central nervous system. 2. An anterior root composed of (1) efferent, non-ganglionated, splanchnic and somatic fibres, and (2) efferent, ganglionated, splanchnic fibres, characterized by the fineness of their calibre, the ganglion of which is vagrant and has traveled to a variable distance from the central nervous system. The cranial nerves are then considered seriatim.

The optic and olfactory nerves do not conform to the type of a segmental nerve and are not discussed.

The IIId nerve is efferent in function. It consists of large and small fibres; as it approaches the oculomotor ganglion the large fibres pass off to supply the eye muscles and the small fibres form a separate group and pass into this ganglion, which is therefore considered a typical motor ganglion. The IVth nerve is also efferent in function, and consists of a large fibred and a small fibred portion, but no ganglion cells have been found along its course. As to the afferent fibres of these nerves—both the IIId and IVth possess within themselves degenerated structures which appear to Gaskell to have been originally the nerve cells and nerve fibres corresponding to the cells and fibres of the stationary ganglion on the posterior root of a spinal nerve. These two nerves, then, form the primary segmental nerves of the first and second segments, the function of the degenerated sensory elements being performed by the *ramus ophthalmicus profundus* of the Vth.

The VIth is purely motor; it contains somatic fibres, while the so-called motor part of the Vth contains splanchnic efferent fibres, but no somatic ones; therefore, taking these two nerves together, we have a complete segmental nerve, as far as efferent fibres are concerned. Here, again, we find that the roots of the motor part of the Vth contain within themselves the remains of nerve fibres and ganglia which would correspond to the afferent fibres and posterior ganglion. The *ramus maxillaris superior* of the Vth, which with the *ramus ophthal-*

micus profundus originates in more posterior segments, has replaced the lost sensory elements of the original nerve of the third or mandibular segment.

The VIIth nerve is a splanchnic efferent nerve consisting of both large and small fibres, the small fibres passing into the geniculate ganglion, which would therefore be the ganglion of the anterior root. As to the somatic efferent fibres, Gaskell has not been able as yet to find these. In this nerve, too, the degenerate remains of the sensory fibres and ganglion are found.

The VIIIth nerve is dismissed from consideration, since it is a nerve of special sense, and this might possibly justify its claim to an independent position. Summing up, then, we find that "in the group of motor cranial nerves, formed by the IIId, IVth, VIth and motor part of the Vth, and VIIth nerves, we have at least four fully formed segmental nerves which for some reason or other have lost a certain portion of their original components."

"In the group of nerves which arise from the medulla oblongata we find all the components which make up a fully formed spinal nerve, or rather group of nerves; here, however, there is no sign of any degeneration of any special group of fibres, but rather a dislocation and scattering of the different components, so that the cranial nerves of this group form parts of a number of segmental nerves instead of each one forming a single nerve." Both the IXth and Xth are purely splanchnic nerves. Each possesses two ganglia: the *ganglion jugulare* and *ganglion petrosum* on the one hand, and the *ganglion jugulare* and *ganglion trunci vagi* on the other. Gaskell considers that the two jugular ganglia represent the stationary afferent ganglia of the IXth and Xth nerves, while the *ganglion petrosum glossopharyngei* and the *ganglion trunci vagi* represent the vagrant efferent ganglia. The spinal accessory consists of large and small fibres. The large ones arise in all the roots of the nerve, the small fibres are confined to the medullary and upper cervical roots, and pass into the *ganglion trunci vagi*. All the fibres are splanchic efferent fibres. The hypoglossus is a purely somatic motor nerve. It represents the separated somatic efferent fibres of this region.

The origin of the fibres of the cranial nerves as well as the structure and function of their peripheral nerve fibres, goes to prove the spinal nature of the cranial nerves, for the groups of cells, which give origin to the cranial nerves, are the direct

continuation of the corresponding cell-groups found in the spinal region.

Having homologized the spinal and cranial nerves, Gaskell formulates a theory of the origin of the central nervous system of vertebrates, to explain the degeneration in the anterior groups of cranial nerves. The central nervous system of the vertebrate, considered anatomically and morphologically, suggests two modes of origin which are apparently antagonistic to each other. The segmental arrangement of the nerves and the cells, from which they arise, points to the conclusion that the nervous tissue of the animal, from which the vertebrate arose, was arranged in a distinctly segmental manner. On the other hand the evidence of embryology points to the fact that the formation is tubular. Any theory must then take both these into account. Schwalbe concludes that the evidence points to the origin of the spinal cord from a bilateral chain of ganglia connected together by means of transverse and longitudinal commissures. Gaskell adopts Schwalbe's view, with the addition to this system of another system of higher function, *i. e.*, the cerebrum, cerebellum, etc., connected with the spinal system through the pyramidal tracts, the direct cerebellar tracts and others. This system is not represented in the spinal cord, and does not give rise to any outgoing nerves except nerves of special sense. Beside the nervous structures of the cord, we have the supporting structures; both of these arise from the medullary tube. As to the connection between these two structures, Gaskell holds that both phylogenetically and ontogenetically the evidence points to the fact that "the central nervous system of the higher vertebrate has been formed by the spreading and increase of nervous material over the walls of an originally non-nervous tube, the cellular elements of which tube, whatever may have been its original function, have been utilized as supporting structures or have undergone gelatinous degeneration. Tailwards this tube emerges free from the encasing mass of nervous matter as the neurenteric canal and its walls are continuous with those of the alimentary canal. Headwards this tube passes into the third ventricle and has apparently no anterior opening." The spinal system of vertebrates corresponds to the infra-œsophageal ganglia and ventral chain of invertebrates, while the crura cerebri, peduncles of the cerebellum and other tracts extrinsic to the level of the ventral ganglion chain form the œsophageal collar, the system of higher function corresponding to the supra-

œsophageal ganglia. It follows necessarily that the tube around which the nervous matter has been formed, *i. e.*, the central canal and ventricles, represents part or the whole of the alimentary canal of the vertebrate ancestor. The author believes that he has found in the infundibular region the remains of the terminal œsophageal tube. In the light of this view we have sufficient reason for the degeneration of certain components of the foremost group of nerves, for with the loss of function of the invertebrate alimentary canal, and mouth parts in connection with it, the sensory parts of the nerves supplying that region degenerated.—*Leah Goff.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHROPOMETRY AS APPLIED TO THE DETERMINATION OF THE ATTRIBUTES OR POWERS OF THE MIND OF MAN.—This is a problem. My only purpose is to consider its feasibility. Its benefits will be apparent. Can it be done?

It will not do, in this age of science, to determine on the entrance to the consideration of a given subject that its discovery or elucidation is impossible because of its extent, distance, mystery, or difficulty. These may be a bar to its discovery, but not to its consideration or attempted discovery.

The scientific discoveries made within the last few years are sufficient answer to this. What question presents greater apparent difficulties—impossibilities that the knowledge that the composition of the flame of the sun or the fixed stars—yet the solar and stellar spectrum has resolved these into their original elements, and we know them as well as we do that of the candle or the coal, which burn before our eyes.

Professor Langley has just informed us that the greater part of the sun's rays are not luminous, and that those which are, are really blue, and not white.

Who could have foreseen that when Galvani, of Bologna, in dissecting a frog (what nonsense, for a great philosopher to fool away his time dissecting frogs!), should have touched with a wire a given nerve, and that the twitch it made in response to his touch should have since then run through a million

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

miles of wire, over the land like the network of the fowler, and through the sea like the seine of the fisherman, until with its sudden cession, the trade, commerce, and government of the world would come to a standstill?

Professor Bell, one of our countrymen, has taken one of these wires—it may be a thousand miles long—and put on it at one end a patent mouth and at the other a patent ear, which can speak and hear with as much distinctness as if they were both attached to the same head.

The latest invention is a machine, about the size of a small sewing machine, into which one may speak in his natural voice, then boxing up his speech, may, after a thousand years of time, or at a thousand miles distance, by the simple turning of a crank, unwind the same speech in the same tone and voice as it was spoken.

Surely, there is much new under the sun.

After this preamble upon the possibilities of science, let us see if we may not measure and record in figures the attributes of man's mind.

Man holds communication with the outside world through his five senses. The action of either of those produce a sensation. Sensation produces perception, and perception intelligence. If we can measure the sensation we are on the road to measuring the perception, and so on, to the understanding and intelligence, and possibly the mind in its more subtle and abstruse operations.

What a conquest of science if we could be able to measure the sensations produced upon the mind, and passing through the upward scale, to calculate the mental force expended, say by Webster in his great constitutional arguments, or by determining the vividness and depth of perception, and so of understanding; to be able to calculate, by mathematical formulas, the reserve mental power necessary to make such arguments.

Decision requires an entire mental operation. It pre-supposes choice; choice, discrimination; discrimination, impression or sensibility; and this, sensation, which is obtained through one of the organs of sense. The operation of this organ, say of sight, can be easily measured, and one step accomplished. Is it not possible to continue it further?

The higher and more complex operations of the human mind may not now be measured. But why not the lower and simpler? When thus measured in different individuals may not their differences denote their differences in mental calibre?

One child knows a letter or figure, remembers it, understands it, on seeing it once; another requires twenty times; while the learned pig can only spell or count on being shown the same letter or figure, a hundred, maybe a thousand times.

Animals can be taught many mental operations. I recall the performing elephants, dogs, bears, monkeys, birds, even the fly and the flea, while Sir John Lubbock has ascertained the sensibility of the ant in the matter of sight, hearing, smell, and has shown that he can receive impressions through these senses which lead up to perception, understanding and decision. Sir John discovers that the ant has a goverment, and consequently a governor. He will emigrate to any other country, can organize an army, make raids, fight battles, take prisoners whom he enslaves. It is highly interesting to count the needed sensations, impressions, and perceptions required to perform all these mental operations.

The same system by which this can be measured or counted in our experiment with the animal can be applied to man.

What are school examinations or college commencements but tests by measurement or counting of the mental capabilities of the students? They may be only for comparison one with another; but that comparison is made by measurement more or less indefinite. At West Point and Annapolis the comparison is made with an absolute standard, in which 1000 is perfection. The system may be anomalous, for unblacked shoes and unkempt hair may so reduce it as to defeat his promotion.

Color blindness and astigmatism are measured by the oculist. They may be diseases or caused by defective mechanism, but these are only determined by measuring the sensations produced in the mind.

The measurement of a mental sensation is something accomplished, and I would pursue the same line of investigation to its end. Examine the candidate for the *truthfulness*, the *fidelity* of his sensation. First as to his sense of color. The question is, what sensation is produced upon his mind by the sight of a strand of worsted of a given color? Does green give the proper sensation, or purple, or red? This is a test of the *correctness* of the impression as to color. The operation is done leisurely. Rapidity is not now required. It is *accuracy* which is now being tested. As his examination progresses mark on the chart his successes or his failures. The fault in his sense of color may result from a species of disease. But

now we test his sensation as to size, form, etc., which is not affected by disease, but it is a question purely of truthfulness of sensation or impression. Show him a yard stick, and let him mark the middle of it—divide it into feet or inches. Let him do it slowly but correctly. Compare two lengths—draw parallel lines, some true and some untrue—try him with angles, right, and other than right. Invent methods to test the correctness of his impression on his mind as derived from the operation on the sense of sight.

As a second lesson or course give him the chalk and let him make on the board the lines which he has just tried. Let him make a straight line of certain length; an inch, a foot, a yard —a right angle, a square, a circle, parallel lines, etc., etc.

Having exhausted correctness, test him for rapidity—have him do the same things and in addition to correctness, require rapidity.

To correctness and rapidity in such elementary matters let us add the test of power of observation, that is, the capacity to *see* things, to see them correctly, rapidly, and to note their number, position, quality, etc. This is only to note the sensation obtained from a larger view than the sticks and lines first shown. It is still the mental impression derived from the operation of the sense of sight.

March the candidates or class into a room, stay five minutes, and out again—then describe every article seen; try one minute; try unfamiliar rooms; try a picture; conduct them past an open door at a slow pace, and then ask them to tell every article seen in the room.

All these tests can be registered for each candidate, and the result will be his mental capacity in each of these regards, correctly expressed in figures.

Then try him with the sense of hearing, of touch, possibly of smell. You will say this will sharpen his senses. I prefer to say it will sharpen his *wits*—that it educates him, it causes him to correctly note the impression of the object as presented to the senses and as correctly to report or carry it to his mind. All this is but that mental quality called attention. After attention, memory. Thus we may measure by Anthropometry the mental qualities of sensation, impression, attention, and memory.

These are the faculties by which the mind of man receives its communications from the world. By their means it obtains the raw material to be worked up in the laboratory of thought.

MEASUREMENT OF MAN'S REASON.

How many are twice two? Twice ten? Easy enough to tell. How many are twice 17.648? Seven times that? Twelve times that? The mental operations required are those we have just been measuring, and we who have perceived in them the highest grade will succeed here the best. First attention to impression and sensation, then correctness, and finally, rapidity. All these tests to be recorded. Thus we may progress through mathematics, logic, philosophy, and so on to the end, practicing continually our first and fundamental rules of Attention, and Correctness of Impression, or Sensation.

The thoughtful man can follow this system out in detail, can perceive how it can be accomplished. I can see how, by the introduction of some such system, not only the average mental capacity or power of a nation or a people might be measured, the result announced in figures, and a comparison made with other nations; also that its use might tend to increase that capacity and power.

Such are the higher uses of Anthropometry. The human mental capacity *to understand* things is nearly allied to its capacity to *see* things. If one can be done I should not despair of the other. Whatever can be done with either must be by experiment directed by observation, Experiments must be repeated and the observations recorded. This means counting and measuring; and this applied to man is the Science of Anthropometry.

These are some of the possibilities of Anthropometry, but they are as yet far beyond the scientists of the United States.

We must content ourselves for the present with obtaining full, complete, and reliable tables of measurements of the physical peculiarities of the various races which inhabit our country. This should be our immediate contribution to the world's science.

MICROSCOPY.[1]

THE RETINA OF THE BIRD. — Cajal[2] recommends the method of Golgi for the study of the retina. He proceeds as follows:

[1] Edited by C. O. Whitman, Clark University, Worcester.

[2] Anat. Anz., iv., No. 4, Feb., 1889, p. 112.

The fresh retina is left for two or three days in a mixture consisting of

Bichromate of potassium (3 %) - -	4 parts
Osmic acid (1 %), - - - - -	1 part.

It is next placed in nitrate of silver solution (¾%) 24-30 hours. The sections are cleared in oil of cloves and mounted in damar.

CELL DIVISION.—Rabl[1] recommends the following method of preparation for the study of the caryokinetic phases in Triton.

The larvæ are treated with chloride of platinum ($\frac{1}{10}$ - $\frac{1}{8}$ %) 24 hours, then thoroughly washed in water, and slowly hardened in alcohol. The floor of the mouth and the gills are then cut out, stained in Delafield's hæmatoxylin, or Czokor's alum cochineal, *and examined in methyl alcohol.* In media of higher refractive index the finer details are not seen. The preparations last only for a few days.

DEMONSTRATION OF THE TONOPLAST.—Professor Vries[2] has shown that the vacuoles of plant cells represent organs with distinct and very resistant walls. In harmony with its function the wall is called the tonoplast. Aleuron granules are tonoplasts with their contents in a dried condition. The demonstration of the tonoplasts is accomplished by a 10% solution of nitric acid reddened with eosin. The method may prove useful in the case of animal as well as plant cells.

THE PRESERVATION OF ACTINIÆ.[3]—The preservation of Actiniæ in a suitable condition for future study is a matter of some difficulty, and has greatly hindered a thorough study of the group. The great difficulty experienced in killing the animals sufficiently rapidly to prevent contraction is the main obstacle, and the method of first producing torpor by the use of chloroform or nicotine, as practiced by the Hertwigs ('79), is tedious and not always successful. I was in hopes that good results might be obtained by the use of cocaine, but my experiments with it gave negative results. The success of any method depends greatly on the character of the form under

[1] Anat. Anz., iv., 1, Jan. 10, 1889, p. 30.

[2] Hugo de Vries, *Intracellular Pangenesis*, 1889, p. 150.

[3] J. Playfair McMurrich, Actiniaria of the Bahamas, Journ. Morph., iii., 1, p. 2, 1889.

treatment. Methods which will give good results with the Zoantbidæ, for instance, will yield failure quite as often as success with more contractile forms. For a collector who cannot give the time required for the proper carrying on of the narcotizing methods, my experience has led me to advise the following method of procedure. After the general characteristics —the coloration, presence or absence of tubercles, the dimensions, and such easily observable features—have been carefully noted with as much detail as possible, the animal is placed in a jar just wide enough to allow its complete expansion, and with just enough water to cover it when fully expanded. When this condition is reached, a glass syringe is filled with Perenyi's fluid, and this is suddenly and rapidly injected into the interior of the animal, the nozzle of the syringe having been quickly inserted into its mouth. At the same time, if possible, a quantity of the same fluid is poured over the animal, so that it is bathed without and within with a tolerably strong mixture of Perenyi's fluid. It is left to the action of the fluid for about half an hour, and is then to be treated successively with 50, 70 and 90 per cent. alcohol, care being taken to inject a considerable quantity of the spirits into the interior at each change.

Although considerable contraction usually results from this process, and although the color is, as a rule, almost destroyed, yet I think the distortion is less than that resulting from most other methods, and there is the great advantage that the parts are preserved in a satisfactory manner for future histological study. Dissection is possible, owing to the absence of the excessive brittleness which results from the use of chromic acid, encrusting or attached calcareous particles are dissolved, and sectioning of entire small forms may be practiced without the danger of ruining the knife, and lastly, there is no unpleasant precipitation of crystals as occurs from the use of corrosive sublimate when the subsequent washing has not been sufficiently prolonged.

THE PREPARATION OF BONE AND TEETH WITH THEIR SOFT PARTS.[1]—Dr. L. A. Weil takes only fresh, or nearly fresh teeth, and in order to allow reagents and stains to penetrate into the pulp cavity, divides the tooth immediately after extraction with a fret-saw, below the neck, into two or three

[1] *Internat. Monatschr. f. Anat. u. Physiol.*, v., 1888, Heft 1, *Journal Roy. Mc. Soc.*, 1888, Dec., p. 1042.

pieces, "allowing water to trickle over it the while." The pieces are then laid in concentrated sublimate solution for some time to fix the soft parts. After this they are washed in running water for about one hour, then placed in 30 per cent. spirit, which in twelve hours is changed to 50 per cent., again, after a similar period, to 70 per cent. Then, in order to remove the black sublimate precipitate, the teeth are laid for twelve hours in 90 per cent. spirit, to which 1.520 per cent. tincture of iodine has been added. The iodine is afterward removed by immersion in absolute alcohol until the teeth become white.

For staining, alcohol, or an aqueous solution of borax carmine, gave the best results. From the absolute alcohol the teeth are removed to running water from fifteen to thirty minutes, and then placed in the stain. In the aqueous solution of borax carmine they remain one or two, in the alcoholic two or three days. They are then transferred to acidulated 70 per cent. alcohol (alcohol 100 ccm., acid. muriat., 1.0) in which they remain, the aqueous ones stained at least twelve, the alcohol-stained ones twenty-four to thirty-six hours. This done they are immersed for about fifteen minutes in 90 per cent. alcohol, and then for half an hour in absolute alcohol, after which they are transferred to some etherial oil for twelve or more hours.

The oil is then quickly washed off the objects with pure xylol, and then they are placed for at least twenty-four hours in pure chloroform. After this they are passed into a solution of balsam in chloroform. The balsam is prepared by drying in a water bath, heated gradually up to 90°, for eight hours or more, until when cold the mass will crack like glass on being punctured. Of this balsam so much is added to the chloroform as to make a thin solution in which, as before mentioned, the teeth lie for twenty-four hours. After this time as much balsam is added to the solution as will dissolve. When no more balsam will dissolve, the teeth and a sufficiency of the balsam are poured into a vessel and heated up to 90° in a water bath, until the mass when cold should be as hard as glass. When the balsam is sufficiently set the teeth are carefully picked out, placed in a vice, and their discs are cut from them with a fret saw, water being allowed to trickle over them the while, and then they are ground in the usual way. The preparations are mounted in chloroform balsam.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Dr. G. H. Williams[2] has identified upon the island of Fernando de Noronha, the following rock types: hornblende-trachyte, trachyte glass, hornblende-andesite, phonolite, nepheline rocks, augitite, limburgite and basaltic bombs and tuffs. In the phonolites, ægerine occurs both in porphyritic crystals and in the groundmass. In the crystals of the groundmass the inclination of the axis of greatest elasticity to the vertical axis is $7° 42'$—$16°$. Their pleochroism is $B =$ green, $A =$ green, $C =$ yellow. Among the nepheline rocks are basanites, dolerites and basalts. In the dolerites are brownish-red augite crystals which are distinctly pleochroic in reddish-brown and greenish-yellow tints. They are zonarly developed with the exterior zones more highly colored than the interior ones.—A recent article by E. S. Dana[3] in the petrography of the Sandwich Islands is so full of interesting statements that a brief review of it is very unsatisfactory. The lavas of Mauna Loa and of Kelauea are of the same general character. They are basalts and olivine-basalts in numerous varieties. A fine-grained clinkstone-like basalt from Loa is remarkable for the beautiful feather-like groupings of augite microlites discovered in all specimens examined. Many of the augite microlites are intergrown with lath-shaped crystals of plagioclase, the two minerals radiating from a common center, and the latter often capping the tufts of the former. The olivine-basalt from the same crater contains many crystals of olivine in peculiar forms, some of which are slender acicular crystals elongated in the direction of their c axes. They often possess an unusually deep green color, when they show strong pleochroism. In the Mt. Loa lava streams are caverns from whose walls delicate stalactites of lava project. These are described by the author in great detail and are pictured with great minuteness. The stalactites are often solid throughout and possess a concentric structure. They are crystalline, except on the outside, where they are covered with a thin coating of glass, transversely marked with fine flowage lines. Frequently a large portion of the volume of a stalactite consists of cavities, whose walls are lined with large rhombic scales of clear plagioclase, needles of augite and octhedra

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Am. Jour. Sci.* March, 1889, p. 178.

[3] Ib. June, 1889, p. 441.

of magnetite. The lavas of the island of Maui and of Ohua are also principally olivine-basalts, in which augite is often zonally grown around olivine crystals. In the western portion of Maui is a whitish-gray compact rock, composed almost exclusively of plagioclase, with a very little altered hornblende, brolite and magnetite. Since it contains 61.63% of SiO_2 it is probably to be referred to the andesites.—An interesting communication by Rutley on the possible origin of epidosites appears in the Quarterly Journal of the Geological Society.[1] Altered felsites with a perlitic structure occur near the Hereford Beacon, Malvern Hills. The rock is gray in color, and is traversed by a delicate network of quartz veins containing epidote grains and curved lines of epidote, which by their green color and strong double refraction mark out the direction of formerly existing perlitic cracks.[2] The epidote is thought to have originated from the feldspar of the felsites, either directly or indirectly through the interposition of kaolin by the action of solutions of carbonates of calcium and iron, which would naturally circulate most readily through the perlitic cracks. By a continuation of this process epidosites might arise through the entire change of the material of the felsite into epidote and quartz.—The ejectamenta thrown out by Vulcano have recently been studied by Johnston-Lavis.[3] The most abundant products of this volcano are bombs whose surfaces are broken by fissures, and pieces of foreign rocks. The material of the bombs is obsidian, containing as inclusions pieces of basic rocks, and minerals resulting from these by alteration. The ashes accompanying these bombs consist of fragments of basic and acid glassy rocks, which the author believes to have been broken from the sides of the volcanic vent. The existence of pyrites in the material of the bombs, as well as the presence in it of olivine and augite with perfectly sharp angles, leads to the conclusion that the temperature of the lava from which the bombs were formed was low.—The obermittweide conglomerate from a point in the Mittweide valley, twenty-five miles south of Chemnitz, has been subjected to investigation by Bonney,[4] who finds the matrix to have been derived largely from the detritus of a biotite granite, and to have undergone

[1] November, 1888. p. 740.

[2] AM. NAT., 1887, p. 1112, where it is stated that the author regarded the mineral filling the cracks as topaz.

[3] Nature, p. 111.

[4] Quart. Jour. Geol. Soc., 1888, No. 173, p. 25

such alteration that it may now be regarded as crystalline. It consists of quartz, two micas, and a little feldspar. The constituents exhibit a slight tendency to parallelism, but show little evidence of squeezing.—The same writer[1] announces the discovery of a variety of picrite, known as scyelite, on the island of Sark in the British Channel. It is composed of serpentinized olivine, altered augite and bleached mica, some of which exhibits a banded twinned structure, one set of bands extinguishing parallel to the cleavage of the mineral, and the second band 18° to this cleavage. The rock was not found in place.—Joly[2] has discovered the presence of iolite in a feldspathic substance associated with beryl in the granite of Glencullen Co., Dublin, Ireland.—Upon treating the quartz-porphyry from Teplitz with hydrofluoric and sulphuric acids, von Foullon[3] obtained in the residue little grains of corundum.

MISCELLANEOUS.—In a little pamphlet entitled "Ueber das Verhalten der Silicate beim Uebergange aus dem gluthflüssigen in den festen Aggregatzustand," Nies[4] discusses the occurrence of crystals of silicates in lava streams, describes the action of water, metals, and alloys in passing from the solid to the liquid state, calls attention to the contraction forms in eruptive rocks, and concludes that silicates probably expand upon their crystallization from a molten magma, and do not contract as has been generally stated, but that not enough facts are known to warrant a positive statement on either side. The apparent contraction is due to the fact that the specific gravities of crystallized and amorphous bodies have been taken while both were cold, and, therefore, that they can not be regarded as criteria upon which to base conclusions as to the relations of the substances in the two different conditions at a high temperature. Their different relations at a higher temperature are due to the more rapid expansion of crystalline substances than of amorphous ones.—An interesting contribution to the study of morphotropism has recently been made by Dufet,[5] who has carefully investigated the mixed crystals produced upon the evaporation of a solution of zinc and magnesium sulphates. As a result of his measurements of certain

[1] Geol. Magazine, March, 1889, p. 109.
[2] Geological Magazine, 1888, p. 517.
[3] Verh. I. k. k. geol. Reichsanst. 1888. No. 8, p '
[4] Stuttgart. 1888. Schweizerbartsche Verlagshand.
[5] Bull. Soc. Franç. I Min. xii. p. 22.

interfacial angles he concludes that the values of these are the means of the values of those of the two simple sulphates, calculated in the proportions of their molecular combinations. The author proposes to study other mixed salts in the same way. McMahon[1] makes use of a thin quartz wedge for the determination of the strength of the double refraction of minerals in their rock sections. The quartz wedge is inserted between the crossed nicols of a microscope at an angle of 45° to their planes of polarization, and the point is noted at which there is no double refraction apparent when the object under investigation is placed on the microscope stage. This point of no double refraction is indicated by a dark line crossing the field. Its position varies with the strength of the double refraction of the mineral, so that by comparing its distance from the end of the quartz wedge with the distance observed in the case of minerals of known strength a ready means is afforded for a rapid determination of its double refraction.

Heririg[2] mentions the existence of a grotto in the Waschgang Mine at Döllach in Corinthia, whose walls are covered with well formed ice crystals, some measuring as much as 200 mm. in diameter.—Fulgurite glass from lightning tubes in a glaucophane epidote schist, in which occur yellow garnets, sphene, and occasionally diallage, is described by Rutley from the top of Monte Viso. The interesting fact in connection with this fulgurite is the existence in the tubes of a vesicular glass in which gas bubbles, and globulites and microlites are scattered.

In an article entitled the "Physics of Metamorphism," Harker[4] calls attention to the influence of pressure in effecting changes in the character of rock masses, and divides metamorphism into hydrothermal dynamo, and plutonic metamorphism, the meaning of each of which terms he explains in some detail In a red copper slag from the Canton Copper Works, Baltimore, Messrs. Jarman and McCaleb[5] have discovered cuprite in little octahedral crystals.

MINERALOGICAL NEWS.—Much additional[6] knowledge in regard to the sulphates occurring near Copiapo, Chili, has

[1] Geological Magazine 1888, p. 548.
[2] Zeits. f. Kryst. xiv. p. 237.
[3] Quart. Jour. Geol. Soc., Feb. 1889, p. 60, and Geol. Mag., 1889, p. 42.
[4] Quart. Jour. Geol. Soc., 1889, p. 15.
[5] Amer. Chem. Jour. Vol. II., p. 30.
[6] AMERICAN NATURALIST, 1888, pp. 930 and 1022.

been gathered by Luck,[1] who has made an extensive crystallographic and chemical study of them. *Coquimbite* is declared to be rhombohedrally hemihedral with $a : c = 1 : 1.5613$. Its hardness is 2—2.5 and specific gravity = 2.079—2.114. *Copiapite* has been determined to be monoclinic with $a : b : c = .4791 : 1 : .9759$ and $\beta = 71° 56'$. The mineral cleaves parallel to $\infty P \breve{\infty}'$ and $\frac{4}{9} P\overline{\infty}$. Its hardness is 2.5 and specific gravity 2.103. Analysis yielded:

SO_3	Fe_2O_3	Ae_2O_3	CaO	H_2O
38.91	30.11	tr.		30.74, corresponding to

$Fe_4 (HO)_2 (SO_4)_5 + 18$ Aq. *Stypticite* occurs in radially fibrous aggregates of a yellowish-green color. Its hardness is 2.5 and specific gravity 1.857. Its crystalization is probably monoclinic. Its composition was found to correspond to $Fe_2 (OH)_2 (SO_4)_2 + 9$ Aq. Upon alteration it gives rise to a grayish-yellow substance what is probably identical with *fibro ferrite*. Tabular crystals of *römerite* and found to be triclinic with $a : b : c = .9681 : 1 : 2.6329$ and $\alpha = 116° 2' : \beta = 94° 41' : \gamma = 80° 8'$. Its cleavage is basic, hardness 3 and specific gravity 2.102. An analysis of pure material leads Linck to regard the mineral as $Fe (Fe Al)_2 (SO_4)_4 + 15$ Aq. Chilian *halotrichite* yielded on analysis:

SO_3	Ae_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O
33.98	10.43	.95	5.55	.69	.78	46.94

Among these sulphates is one occuring in reddish-violet, tabular crystals, in habit resembling gypsum crystals. It is monoclinic with $a : b : c = .3942 : 1 : .4060$. $\beta = 77° 58'$. Most of the crystals are elongated in the direction of the clino diagonal. The plane of the optical axes is in $\infty P \breve{\infty}'$ and the first bisected is inclined to c in the obtuse angle β. The the double refraction is negative, hardness 2.5, specific gravity 2.1155. Its composition is

SO_3	Fe_2O_3	Al_2O_3	CaO	MgO	H_2O
39.83	27.66	tr.	.40	tr.	31.35

corresponding to $Fe_2 (SO_4)_3 + 10$ Aq. The author calls the mineral *quenstedite*.—Some interesting pyrite crystals are described by Mr. W. B. Smith[2] from the mines in Gilpin and Summit counties, Colorado. The crystals from the Saratoga mine in the former county are remarkable for the large num-

[1] Zeits J. Kryst. xv. p. 1.

[2] Proc. Colorado Scient. Soc. 1887, pp. 155 and 17

ber of forms occuring upon them. Interpenetrating crystals with the twinning axis normal to ∞O, consist of modified cubes, which are brought into such a position by twinning that the striations on parallel cubic faces cross each other at right angles. Other crystals contain on their cubic faces striations that appear to be discontinuous. The crystals are probably contact tronis with $\infty O \infty$ the composition face. The crystals from Summit county occur in almost ideal perfection in a mass of kaolin in the vicinity of Monte Zuma. *Alabandite* from the Queen of the West mine in Summit county, *manganite* from Devil's Head, Douglas county, crystals of *dioptase* ($\infty P2$ and $-2R$) from near Riverside, P.O., Arizona, and *garnets* from Chaffee county, Col., are also described by the same mineralogist. Repeated trillings of *vanadinite* from the Alice mine, Yuma county, Arizona, consist of crystals united by their prismatic faces and therefore resembling simple crystals. These groups of three crystals sometimes enclose a hollow triangular space running longitudinally through the center of the group. In a lot of *wulfenite* crystals from the Red Cloud mine in Yuma county were found a few tronis with the composition plane ∞P. They produce elbow-shaped forms with the two limbs bent at right angles to each other. Fine *quartz* and *epidote* crystals, all of the latter of which are twinned parallel to ∞P occur in pockets in a peculiar rock composed of epidote, calcite and pyroxene, overlying a stratum of limestone at Calumet, Col. Some new facts are stated regarding the *phenacite* from Mt. Antero, and a new locality for the mineral is mentioned as existing half a mile distant from the locality already known. In the second place, the phenacites have a rhombohedral habit in consequence of the development of a rhombohedron of the third order. The pocket in which these crystals are found contains also many Baveno twins of white microline upon which most of the phenacite was implanted.—The *feldspar* of the nepheline and lencite basamites of Kilimandjaro examined by Fletcher a year or so ago[1] has been re-examined by Hyland[2]. The fresh mineral is pearl-gray in color, with a light vitreous lustre. Crystals containing the faces oP, $\infty P \breve{\infty}$ are twinned parallel to $\infty P\bar{\infty}$, with this face also as the combination plane. In some of these an interior, twinned nucleus is surrounded by a zone of untwinned material, which can be removed from the former by

[1] American Naturalist, 1888, p. 930.
[2] Geological Magazine, April, 1889, p. 160.

mechanical means so as to leave a kernel with the shape of a Carlsbad twin. The cleavage of the mineral parallel to oP and ∞ P' ∞̆ are inclined to each other at an angle of 90° 3'. Between crossed nicols plates cut parallel to oP show twinning lamellæ of variable breadth extinguishing at 1°—3½°. Sections parallel to ∞ P ∞̆ possess an extinction of 5°—6°. A chemical examination of purified material gave:

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O	Sp. Gr.
61.35	23.10	3.02	5.34	7.11	.09	2.63

Its composition corresponds to $An_1\ Or_{2.1}\ Ab_{4.02}$. Since the mineral is undoubtedly triclinic Hyland would call it *soda microcline* as suggested by Brögger.—Intermingled with a few notes on new occurrences of minerals in Pennsylvania and New Jersey, Mr. Eyerman[1] records the analysis of *calamine* from Friedensville, N. J., and of *apophyllite* from St. Peter's, Chester Co., Pa., as follows:

	SiO_2	Fe_2O_3	QnO	CaO	K_2O	H_2O
Calamine,	24.32	2.12	65.05			7.86
Apophyllite,	51.63			25.42	6.25	16.58

—The same writer[2] describes large crystals of *pyrite, chalcopyrite, apophyllite, stilbite, garnet* and smaller crystals of *calcite, orthoclase, pyroxene, aragonite,* masses of *pyrallolite* and *erythrite* and needles of *byssolite* in calcite, all from the shafts of a magnetic mine at French Creek, Pa. The stilbite gave on analysis:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
58.00	13.40	tr.	7.80	1.40	1.03	tr.	18.30

—Abnormally developed crystals of *pyrite* from these mines are mentioned by Mr. Penfield[3] as being lengthened in the direction of one of their axes as to present tetragonal symmetry with all the planes terminating at the extremity of the extended axis curved. The crystals are either simple octahedra or octahedra in combination with pyrotoid faces. It is thought that the abnormality may be due to the development of the planes of the form $\frac{3}{2}$ O.—Crystals of *gypsum* from the salt marshes of Batz, Loire-Infèrieur, France, are so associated

[1] Notes on Geology and Mineralogy, Proc. Acad. Nat. Sci., Phila. Feb. 26, 1889, p. 32-35.

[2] On the Mineralogy of the French Creek Mines in Pennsylvania. Read before the N. Y. Acad. of Sciences, Jan. 14, 1889.

[3] *Amer. Jour. Science*, March, 1889, p. 209.

with iron pyrites and organic calcium carbonate, as to leave no doubt[1] that they have been produced by the action of these two substances upon each other.—Messrs. Clark and Catlett[2] have discovered small quantities of platinum in a mass of sulphide of nickel, iron and copper from the copper mines at Sudbury, Ontario. The principal sulphide in the mass is the rare mineral *polydymite* $(NiFe_4)S_6$.—Mallard[3] has measured the index of refraction for yellow light in the rare mineral *sellaite* from the vicinity of Montiers, and finds $\varepsilon = 1.389$ and $\omega = 1.379$.—Cruciform twins of *thenardite* from Borax Lake, Cal., are stated by Mr. Ayres[4] to have $P\breve{\infty}$ as their twinning plane.—Jannash and Calb[5] have analyzed a large number of specimens of tourmaline, and have reached the same conclusion with reference to the composition of the mineral as was reached by Riggs[6] about a year ago.

PSYCHOLOGY.

THE SENSE OF SMELL IN DOGS.—Under this title Dr. George J. Romanes read a paper at the meeting of the Lumean Society of London, December 16, 1886. After preliminary observations on the faculties of special sense generally, and in particular that of smell, as enormously developed in Carnivora and Ruminantia, the author related his own experiments with a setter bitch. His conclusions are that in the case of this animal she distinguished his trail from that of all others by the peculiar smell of his boots, and not by the peculiar smell of his feet. "No doubt the smell which she recognized as belonging distinctively to my trail, was communicated to my boots by the exudations of my feet; but these exudations required to be combined with shoe leather before they were recognized by her. Moreover, it may be inferred that if I had always been accustomed to hunt without boots or stockings she would have learned to associate with me a trail made by my bare feet. The experiments further show that although a few square millimetres of the surface of

[1] Bull. d. l. Soc. Franc. O. Min., xi., p. 295.
Amer. Jour. Sci., May, 1889, p. 372.
[3] Bull. Soc. Franc. d. Min., xl., p. 302.
[4] *Amer. Jour. Science*, March, 1889, p. 235.
[5] Ber. d. deutsch. Chem. Ges., 1889, p. 216.
AMERICAN NATURALIST, 1888, p. 250.

one boot is amply sufficient to make a trail which the animal can recognize as mine, the scent is not able to penetrate a single layer of brown paper. Furthermore, it would appear that in following a trail this bitch is ready at any moment to be guided by inference as well as by perception, and that the act of inference is instantaneous. Lastly, the experiments show that not only the feet (as these effect the boots) but likewise the whole body of a man exhales a peculiar or individual odor, which a dog can recognize as that of his master amid a crowd of other persons; that the individual quality of this odor can be recognized at great distances to windward, or, in calm weather, at great distances in any direction; and that this odor is not overcome by anise seed."—*Zool., Anz.*, No. 242.

MIND AND CONSCIOUSNESS.—*To the Editor of the Open Court:* You and Mr. Hegeler have expressed the desire (in a letter, December 31, 1887), to know how it happened that in my friendly contention with Professor Cope I have used "consciousness" and "mind" synonymously. I did so partly out of courtesy to my adversary, who habitually makes use of the phrase "mind or consciousness," and partly to carry on the discussion as much as possible on the basis given by himself.

Allow me, however, to indicate as briefly as possible how I myself distinguish "consciousness" from "mind." "Consciousness" is that state of our being in which we are aware of what is usually classified as sensations, perceptions, emotions, thoughts and volitions. When we are thoroughly asleep or in a swoon we are not aware of such affections, and are consequently not conscious.

Consciousness, of course, can be only a *present* phenomenon, a manifestation taking place within us *at the very moment.* When we are conscious of something that has occurred in the past, this retrospective consciousness takes place likewise only in the moment of present awareness. The same holds good with prospective consciousness. We foresee the future only as content of our present consciousness.

I have called this one, all-comprising moment of conscious realization "the mental presence," and have repeatedly pointed out that its contents vanish from moment to moment into nothingness, and are as constantly reconstituted under kaleidoscopic changes, from a persistent vital matrix. Con-

sciousness is always the effect or outcome of some underlying *activity*, never itself the manifesting substrate.

The underlying vital matrix is perceived by us as the nerve-system of organic beings. And *all* the functional activities of this nerve-system contribute toward the production of the mental presence, though many phases of it may remain unconscious; and this not only from their not attaining a sufficient degree of intensity, but also by dint of normal disposition (see "Space and Touch," *Mind*, No. XL.).

When the term consciousness is used collectively for a series of mental states which we experience during an hour or a lifetime, it does not denote an actual phenomenon or veritable existent, but stands merely as a general name, in the same way as "animal" or "plant."

The term "mind" signifies to most persons some active immaterial agent within us, capable of producing or manifesting conscious states. As I do not believe in such an agent, I can rightly speak of mind only adjectively, as when I say: "mental states," and then "mental" is really synonymous with "conscious." Or I can speak of it, at most, as an attribute of our being, as when I say, "our mentality," which is not synonymous with our "consciousness," as it includes also the unconscious working of the brain toward the production of consciousness.

We can, moreover, not well avoid using the term "mental" as an opposite to "physical." This distinction is felt by every one to be legitimate. Yet it is incontestable that everything physical—all matter and all motion—is realized by us solely as perception of our own. We become aware of it as a peculiar kind of conscious event within our own mental presence. A physical fact is, consequently, itself of mental consistency, for it forms part of our own consciousness. And the only essential difference between it and other constituents of our consciousness lies in the fact of its being aroused in us through compulsory sense-stimulation, while other conscious states arise in us without any compulsory influence working upon us from outside our own being.

To become, however, fully alive to the radical contrast obtaining between what we call a "physical" and what we call a "mental" fact, we need only realize that mental facts, as such, are entirely imperceptible through sensory channels, while it is the very characteristic of physical facts to be thus perceptible. I can touch your physical being, hear your voice, and

see your body move and gesticulate; but I cannot touch, hear or see any of your sensations, perceptions, emotions, thoughts or volitions. These are inwardly or retrospectively realized by yourself alone.

The distinction here established is essential. It excludes, first of all, the possibility of our entire being consisting of mind stuff, as believed by Idealists of all shades. And it excludes also the possibility of anything mental being in the remotest degree akin to physical forces, as taught by materialistic thinkers, for no one can deny that we give the name of "force" only to that which is capable of affecting our senses in some way or other, and this is exactly the kind of effect that nothing purely mental can produce.

Yours, very truly,

EDMUND MONTGOMERY.

The Open Court.

GEOGRAPHY AND TRAVEL.

ASIA.—FORMOSA.—Mr. G. Taylor, an Englishman in the Chinese Lighthouse Service, gives in the April issue of the *Proceedings of the Royal Geographical Society* a most interesting account of the natives of Formosa. There was considerable difficulty in establishing a lighthouse at the southern end of the island, among wild natives inimical to Chinese rule, but at last the ground for its erection was fairly bought, and this commencement without bloodshed led to future amicable relations. The Chinamen has ousted the natives from the fertile and highly cultivated plains of the west and north, and even in the south the Chinese squatter has fixed himself upon all the streams, so that the really wild natives have had to retreat to the mountains, especially as many of the native races adopt Chinese customs, settle down, and cultivate the ground.

Formosa possesses only two harbors worthy of the name, viz., Keelong in the north, and Takowin in the west. The first of these can be entered by larger vessels, but the second has the advantage of being more entirely land-locked. The entire island is densely wooded.

There is little doubt that the original settlers were Malay, but physiognomy differs greatly in the same tribe. At present there are four principal races who have preceded the Chinese, viz., the Paiwans, Tipuns, Amias, and Pepohoans.

The Paiwans seem to have been the first settlers, and some are still head hunters, no youth among the wild tribes finding favor with a girl unless he can show a head as a trophy. The Paiwans are a tall, fine-limbed active race of mountaineers, and the women, although small, are symmetrically formed. Their dress consists of nothing but two aprons, one in front and one in rear. Drunkenness is the prevailing vice of the tribe, and has already sapped the power of Paiwan rule in South Formosa.

The Tipuns seem to have come from the north, perhaps from Japan. They must have had considerable civilization when they came, as they were the ruling people in South and East Formosa before the advent of the Chinese. In person they are rather shorter than the Paiwans, less angular, and more inclined to become fleshy. They wear leggings, waist cloths, and long overcoats of buff skin, are an agricultural people, can work in iron and silver, and often intermarry with the Chinese. They have a language of their own, but also speak the tongue of the Paiwans, with whom they are to a considerable extent merged. Pilam, where they first landed, was once the capital, and Tipun headmen were sent to the Paiwan villages. But afterwards the Southern Paiwans, led by some exiled chiefs of the Tipuns, rebelled, and established their independence.

The Amias hold among the natives a lower rank, though they are more muscular and hirsute. They divide time into years, and hold their new year at the end of harvest. There is a tradition among them that they once had written characters, but no traces of these exist.

The Pepohoans seem to be a mixed people, and have a higher civilization than the other tribes. Chinese stories make fun of their simplicity, but intercourse with the Chinaman has given them his astuteness.

The young men of the Formosan natives live in a separate house called a padangkan, as in some African tribes. When a young man has obtained the consent of a girl, he leaves at the door of the parents a bucket of water and some wood. If they agree to the match, the wood and water are taken in, but if not, the lover has still undisturbed possession of his lady love if he can induce her to elope with him.

The Paiwans bury their dead in a spot near his dwelling; the grave is lined with stone, the clothes, arms and ornaments of the deceased are buried with him, and the corpse is placed sitting, facing the nearest high mountain. The grave is then filled up and turfed over. The Tipuns have similar burial customs, but bury within their dwellings. Among the

Tipuns tattooing is practiced upon wrists, etc., but it is a privilege of nobility.

The Amias bury in waste ground, the corpse facing the west; they erect a wooden slab over the spot, and each mourner throws a handful of earth at the grave, and spits at it, repeating a formula telling the dead man that he has been properly treated, and had better stay quietly where he is, or, should he come back, he will be stoned and spit upon.

All the natives are full of superstitions about goblins, etc. They believe that thunder is made by the male divinity throwing things about, and that the lightning is caused by the female uncovering herself. A female uncovers herself if she is evincing the utmost scorn. Some of their stories are about animals assuming human forms.

The Koahuts (a tribe of Paiwans) build neat houses of bamboo covered with straw. The southern Paiwans of Tierasock construct huts of sun-dried bricks, and cover them with thatch. The coast Paiwans are cleanly; they wash and scrub all utensils with sand every morning, and they eat their food with spoons made from a pearly shell. The Tipuns and Amias are scarcely so well housed, nor are they as clean. A Tipun chooses a tree as the centre of his house, and builds around it an irregular hut with partitions. The Tipuns have no tables or spoons; they squat on a billet of wood and dip their hands into a common dish. But the wild Paiwans of the mountains live in a hole dug upon a hillside, and fronted with slabs of slate. When it becomes too filthy to be longer endurable they dig a new hole.

The irrigation practiced by the Chinese has doubtless injured various creeks and harbors, but the island seems to be rising. Anping was an island at the time of the Dutch, but is now joined to the mainland; and an anchor has at another spot been found several feet below ground.

It does not seem that any of the tribes now practice cannabalism, but the coast Paiwans accuse their brethren of the hills, and tell a story of a chief of the Diaramocks who served up his son as a choice morsel to the ambitious chief Tokotok, who aimed to unite all Formosans under his sway.

AFRICA.—THE ZAMBEZI-CONGO REGION.—Rev. F. S. Arnot (*Proc. Geog. Soc., London*, 1889. 11) gives an account of his journey from Natal in search of an elevated spot upon the water-parting between the Zambezi and the Congo, suit-

able for the establishment of a mission. He traversed the Kaohavi and the district of the Bamangwak, but was turned back by Liwanika, chief of the Barotse. He then retreated toward Benguela, but set out again and reached the country of the Gavenganze. Ascending plateux of 4000 to 6000 feet he arrived at Kwanza, and soon after discovered that the great depression Kifumadji, which Cameron believed to be a lake, has no water (save Lake Dilolo) except in the wet season. Then leaving the Upper Zambezi on the right, the traveller entered a mountainous country, where Mount Kaomba form a water-parting between the Congo and the Zambezi. He was favorably received by Msidi, chief of the Gavenganze, and lived there some years before his return. Ivens and Capello had previously visited Msidi. Mr. Arnot says that Livingstone's Leeba is the true source of the Zambezi.

MR. SELOUS' JOURNEY IN THE ZAMBEZI COUNTRY.—F. C. Selous sends an account of his recent and somewhat unfortunate journeys in Africa, accompanied by a sketch map, to the *Proceedings of the Geographical Society*, London. It was Mr. Selous' intention to explore the Kafukwe, an important tributary of the Zambezi from the north, and at first all went well. Monze, the Mashona chief, had seen no white man since Livingstone passed thirty-five years since, and spoke of that event as though it had been last year. With the Mashakalumbwe, a people on the Kafukwe who have no firearms and wear no clothes, but who never go out without a bundle of long, barbed throwing javelins, Mr. Selous had great difficulty, and narrowly escaped with his life. These people, aided by some Marotse, or inhabitants of the Barotse valley, attacked the camp in the night, and by a volley killed twelve and wounded five of his escort. Mr. Selous escaped, and, after having his rifle stolen, and after enduring great hardships, fell in with the remnant of his party. The Barotse valley is a hot-bed of fever, and no white man can hope to escape death if he continues in this part of Africa.

EUROPE.—THE CAUSSES OF THE SOUTH OF FRANCE.—E. A. Martel contributes to a recent issue of the *Revue de Geographie* an article upon the *Causses* of the South of France, a region almost unknown ten years ago, and not rightly known till now. These Causses are calcareous plateaux, not dissimilar in their nature to the mesas of the Colorado region, and

evidently formed as a sediment at the bottom of the secondary sea. These Causses, the highest portion of which rise 1,200 metres above the sea, have, in the course of time become furrowed by canons 400-500 m. in depth. There are four principal Causses and numerous smaller ones. These four, commencing at the North, are: the Causse Sauveterre, which is the least sterile of all; the Causse Mejean, the most arid, elevated and isolated, having an area of 400 sq. kil., and united to another Causse only by an isthmus, which is, in some cases, not more than 10 m. wide; the Causse Noir, which is the smallest and most picturesque of the large Causses; and the Causse Larzac, largest of all, with an area of 1,400-1,500 sq. kil. All these Causses are bare, dreary, monotonous deserts, without water and almost without inhabitants. The rivers that separate them have no above-ground affluents, but are fed by powerful springs and streams that flow from the junction of the limestone with the clay beneath, at the level of the bottom of the gorges. The rains penetrate the limestone at apertures which are called *avens*, sink until they reach the bed of clay and have underground courses sometimes of considerable length. Exploration of the caverns is, however, very difficult, and, indeed, impossible, except to those provided with proper apparatus. M. Martel traced the course of a stream, the disappearance of which had long been a problem to the natives, and discovered two caverns, one of which, Dargilan, has a length of 2800 m. with many large halls, one 190 m. long, and is, in many respects, a rival to the celebrated Grotto of Adelsberg, especially as it has the finest stalactites in Europe.

The finest gorge is that of the Tarn, which for 80 kilo. flows in the depths of a cañon, the walls of which have a mean height of 500 m. One of the greatest wonders of the region is Montpellier-le Vieux, a promontory of triangular shape upon the Causse Noir, above the valley of the Doubré which is here 400 m. deep. At this spot 1000 hectares are covered with what seems like the ruins of a city with its streets, squares, monuments, etc. M. Martel's description recalls the Garden of the Gods and other spots in Colorado.

BOTANY.[1]

THE FLORA OF THE UPPER NIOBRARA.—In the northwestern part of Nebraska there are conditions which have given rise to a flora which possesses unusual interest to the student of botanical geography. Here a spur of the Rocky Mountains extends eastward between the headwaters of the Niobrara River on the south and the White River on the north. This extension of elevated land bears the local name of Pine Ridge. It rises above the great plain as a series of higher and higher ridges and points, until at its culmination it is fully twelve or fifteen hundred feet above the general level to the north and the south. Its southern slopes are less abrupt, but upon its northerly side it is often very abrupt and broken, and here there are multitudes of picturesque and fantastically shaped buttes.

Both the Niobrara and the White Rivers, in this region, run through rather broad flood plains, but their tributaries are all cañon streams, often with high rocky precipices along their banks. Here and there fine springs burst from the sides of the cañons, and give rise to clear, cold streams of pure water. These are more numerous upon the northerly side than upon the south. The elevation of the summit of the ridge is nearly five thousand feet above the sea. The tunnel of an extension of the Chicago, Burlington & Quincy Railway passes through the ridge at a measured elevation of four thousand five hundred feet, and there are numerous points within a short distance which rise fully three or four hundred feet above it.

The vegetation of this region presents an interesting mingling of the Rocky Mountain and the eastern floras. Its most striking feature is the abundance of pine trees. These are all of the Rocky Mountain variety of the Great Yellow Pine of the Pacific Coast. *Pinus ponderosa* var. *scopulorum.* They attain a height of from fifty to eighty or ninety feet, and have often a diameter of from fifteen to twenty-five or more inches. They occur in heavy masses in the cañons, and in more scattered growths upon the slopes and hilltops. So important are these pine forests that many saw mills have been erected near them, and large quantities of lumber have been cut for use in railroad construction and for other uses. Other trees occur only in the cañons. The most important of these are *Negundo aceroides*, *Prunus Americanu*, *Prunus demissa*, *Fraxinus viridis*.

[1] This department is edited by Professor Charles E. Bessey, Lincoln, Neb.

Ulmus Americana, *Populus movilifera.* Occasionally one may find a tree of *Juniperus virginiana*, and on Crow Butte there are numerous specimens of *Juniperus communis* var. *alpina.* Of the lesser woody plants one finds *Celasteus scandeus* in abundance, though far out of its reputed range. *Vitis ripania* and *Ampelopsis quinquefolia* are common, as are, also, *Rhus glabra. R. toxicodendron* and *R. aromatica* var. *trilobata.* Here we find growing commonly the yellow flowered currant, *Ribes aureum*, the Buffalo Berry, *Shepherdia argentea*, and the Diamond Willow, *Salix cordata* var. *vestita.*

Of the herbaceous vegetation only the following need be enumerated: *Thermopsis rhombifolia; Lupinus plattensis; Latteyrus polymorphus; Potentilla auserina; Œnothera albicaulis; Gaura coccinea; Opuretia missousiensis; O. fragilis; Campanula rotundifolia; Asclepias speciosa; Gilia lineasis; Heliotropium convolvolaceum; Krynitzkia glomesata; Yucca augustifolia; Calochostus nuttallii; Stipa spartea; Buchloe dactyloides; Munsoa squanosa; Boutelona oligostachya.* In addition numerous species of *Astragolus*, *Estsgonum*, and of various mountain composites might be noted, but those already given are perhaps sufficiently characteristic.—*Charles E. Bessey.*

KELLERMANN AND SWINGLE'S KANSAS FUNGI.—Fascicle II. of this distribution has been received. It is fully as satisfactory as its predecessor. The numbers are as follows: No. 26. Æcidium callir hœs E. & K.; 27. Æ. grossulariæ Schum.; 28. Æ. penstemonis Schw.; 29. Æ. pustulatum Curt.; 30. Æ. tuberculatum E. & K.; 31. Cæoma nitens Schw.; 32. Cercospora althæina Sacc.; 33. C. diantheræ E. & K.; 34. C. Juglandis Kell. & Sw.; 35. C. polytæniæ E. & K.; 36. C. tuberosa E. & K.; 37. Dendryphium subsessile E. & E.; 38. Entyloma physalidis Cke.; 39. Fusicladium effusena Wint.; 40. Glorosporiam nervisequum Sacc.; 41. Peronospora androsaces Neissl.; 42. Phyllosticta ipomœas E. & K.; 43. Puccinia nigresceus Peck; 44. P. schedonnardi Kell. & Sw.; 45. P. silphii Schw.; 46. Ramularia urticæ Ces.; 47. Srptoria tenella Cke & Ell.; 48. Uromyces graminicola Burrill; 49 U. hyalinus Peck; 50. U. polygoni Fckl.

BAILLOU'S DICTIONNAIRE DE BOTANIQUE.—This work has now reached the 24th fascicle, the latter extending from *Lise* to *Meri.* Among the topics which have notable treatment, either by text or engravings are *Lycopodium*, *Magnolia*,

Marchantia and *Melastoma*. The accompanying colored plate represents a twig bearing leaves, fruit and seed of *Theobroma cacao*, the chocolate tree of full size. The fascicles contain about 80 pages, and are of quarto size. Among the collaborators are Dr. Seynes, Nylander, Dutailly, Weddell, Durand, besides many other specialists.

LUERSSEN'S PTERIDOPHYTA.—In 1884 the first part of Luerssen's work on the Pteridophytes of Germany appeared, and recently part 14, which completes the volume, has come to hand. The work constitutes Vol. III. of the new edition of Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. The treatment of the subject is eminently satisfactory, the text being full, and the illustrations numerous and of fine quality. Some estimate may be made of the fulness of the work when the reader learns that for the eighty-eight species described, we have here a volume of no less than 906 pages.

Luerssen's system is as follows:

CLASS I. FILICINAE Prantl.

Sub-Class I. Isosporeae Sachs.

Section I. Leptosporangiatæ, Goebel.

ORDER I. FILICES L.

Sub-Order I. Hymenophyllaceae Bory.
Family 1. *Hymenophylloideae* Pr.

Sub-Order II. Polypodiaceae Martius.
Family 1. *Polypodieae* Meth.
Family 2. *Aspleniaceae* Meth.
Family 3. *Aspidiaceae* Meth.

Sub-Order III. Osmundaceae Brongu.
Family 1. *Osmundaceae* Brongu.

Section II. Eusporangiatae Goebel.

ORDER II. OPHIOGLOSSACEAE R. Br.
Family 1. *Ophioglosseae* R. Br.

Sub-Class II. Heterosporeae Sachs.

ORDER III. HYDROPTERIDES Willd.
Family 1. *Salviniaceae* Bartl.
Family 2. *Marsiliaceae* Bartl.

CLASS II. EQUISETINAE Prantl.

ORDER IV. EQUISETACEAE Rich.
Family 1. *Equsietaceae* Rich.

CLASS III. LYCOPODINAE Prantl.

Sub-Class I. Isosporeae Prantl.

ORDER V. LYCOPODIACEAE Rich.
Family 1. *Lycopodiaceae.*

Sub-Class II. Heterosporeae Prantl.

ORDER VI. ISOÖTACEAS Bartl.
Family 1. *Isoötaceae* Bartl.

ORDER VII. SELAGINELLACEAE Meth.
Family 1. *Selaginellaceae* Meth.

Our familiar *Pteris aquilina* L. becomes under Luerssen's treatment, *Pteridium äquilinum* Kuhn. So too *Aspidium filix-femina* Sw., the *Asplenium filix formina* Beruh., of the ordinary manuals, becomes *Athyrium filix formina* Roth.—*Charles E. Bessey.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES.—April 24, 1888. Professor Ryder spoke of the displacement of the nucleus of tissue cells and in ova by a large amount of yolk matter.

May 1, 1888. Professor Leidy called attention to some *Menopon perale*, and also spoke of the parasites of the rock-fish.—Mr. Meehan exhibited specimens of the so-called navel orange.—Professor Wilson described some ærial roots in corn caused by abnormal watering of the plant. May 9, 1888. Professor Leidy spoke of the parasites of the pike and the pickerel.—Dr. Meyer described a tertiary barnacle, *Balanus concavus*, occurring in the neighborhood of Norfolk, Va. May 15, 1888. Dr. McCook read a description of four new species of orb-weaving spiders. He also made a communication on the color of spiders. May 29, 1888. Mr. Wilcox called attention to a number of shells beveled and perforated to permit a stick being thrust through for a handle.

June 5, 1888. Professor Heilprin called attention to a col-

lection of specimens obtained from a deep boring at St. Augustine, Fla.—Dr. Chapman described the generative organs of a female spotted hyena from South Africa.—Mr. Meehan spoke of the importance of studying the companionship of plants, and announced the discovery of *Trientalis americana* in the vicinity of Philadelphia. June 12, 1888. Dr. McCook read a description of *Evatypus woodwardii*, a fossil spider. June 19, 1888. Professor Heilprin discussed the age of Laramie. June 26, 1888. Dr. McCook gave a résumé of a paper on the purse weed spiders.—Professor Ryder described the eggs of the sturgeon.

July 3, 1888. Dr. Koenig described some crystals of magapilite.—Mr. Meehan spoke of the so-called flowers of Hydrangea. July 10, 1888. A communication from Dr. Leidy on the fauna of Beach Haven, and on the embryology of *Lepas fascicularis*, was read.—The chairman exhibited a fine specimen of the snow plant.

August 7, 1888. Mr. Meehan spoke on the sexes of flowers.

September 4, 1888. Mr. Meehan and others discussed the polarity of the compass plant.

October 2, 1888. Professor Leidy called attention to the claw of a giant sloth found in the drift in Mills County, Ind., and exhibited a portion of a human skull having four true molars. October 9, 1888. Professor Heilprin made some remarks on the classification of the tertiary deposits. October 16, 1888. Mr. Redfield called attention to a probable hybrid Solanum.—Dr. Morris alluded to the effects of insect bites.—Dr. McCook read a paper on *Lycosa arenicola*. October 23, 1888. Professor Heilprin spoke of the physiography of the Bermuda Islands. October 30, 1888. Professor Heilprin discussed the Bermuda coral reefs.

November 6, 1888. Professor Heilprin described the fauna of Bermuda Islands November 13, 1888. Professor Heilprin continued his remarks on the zoology of Bermudas. November 20, 1888. Professor Ryder presented the results of his study of the skeleton of living forms.—Dr. McCook described a case of double cocoonizing in *Argiope riparia*.—Dr. Rushenberger read a biographical notice of the late George W. Tryon.—Dr. Leidy read a communication on the zoology of Beach Haven.

December 4, 1888. Dr. Morris and others discussed the color of glass due to exposure to heat and air.—Mr. Ives de-

scribed two new forms of star-fish.—Mr. Morris read a paper on subsidence. December 11, 1888. Dr. McCook read a paper on nomenclatures of spiders.—Professor Ryder gave the results of his study of *Mya arenaria*. He also exhibited and described a section of the skin of an elephant. Professor Leidy spoke of the embryology of Lepas. December 18, 1888. Mr. Pilsbry called attention to anomalies in *Helix bermudensis*.—Dr. Foote spoke of Threnardite.—Mr. Morris read a communication on colored glass.—Professor Heilprin summarized the observations made by the recent Greenland expedition.

January 1, 1889. Dr. Koenig exhibited and described a specimen of Anhydrite.—Dr. Leidy discussed the Gregarines. January 8, 1889. Professor Ryder made a communication on the axial skeleton.

February 12, 1889. Professor Ryder read a paper on the development of the calcified skeleton of Chelonians. February 19, 1889. Dr. Leidy described some teeth of a fossil horse from a limestone quarry in Florida.—Mr. Ives reported finding on the omentum of a monkey a number of Pentastomum.

March 5, 1889. Dr. Horn referred to the incrustation of fragments of wood by the mineral constituents of water or soil. —Dr. Leidy exhibited two spiders from Peru, and stated that the tooth of a fossil Llama, from Florida, had been received. March 12, 1889. Dr. Leidy read a paper on Cliona. March 19, 1889. Dr. Brinton exhibited a specimen of *Chrysosplemium americanum*.—Professor Ryder discussed the question of mammalian descent.—Dr. Rex exhibited a specimen of an undersized trichia from Montana.—Dr. Brewer exhibited specimens of yeast and described the development of its cells. —Mr. Wingate exhibited and described a new myxomycete.—Mr. Ives gave a résumé of a paper on "Variation of Color in Star-Fish." March 29, 1889. Dr. McCook explained the structure of spider webs.

April 2, 1889. Dr. Koenig described some Kansasite from Kansas.—Mr. Woolman called attention to the micro-geology of Atlantic City.—Professor Heilprin spoke of the geology of Bermuda and the structure of coral reefs.—Professor Ryder gave the development of vertebræ in certain lower forms.—A communication from Professor Wilson on the production of aerating organs on the roots of swamp and other plants was

read. April 9, 1889. Mr. Meehan made a communication on dogwood.—Mr. Ryder spoke further of his studies of the vertebral column. April 16, 1889. Dr. Hartzell exhibited a section of skin mounted in monobromide of naphthaline.—Professor Ryder commented on the homologies of the jaw of Acanthias in mammalian dentition—Dr. Rex spoke of the interest attaching to common molds and mildew. April 23, 1889. Mr. Wilcox recounted his own explorations of Florida with reference to the geology of that State.—Professor Leidy spoke briefly of the palæontology of Florida.— Professor Heilprin gave a résumé of his study of the fauna of the Bermudas—Mr. Ives described the ophiurans. April 30, 1889. Professor Ryder resumed the report of his study of the development of the vertebral column with especial reference to its growth in the sharks.

May 7, 1889. An invitation from the University of Pennsylvania to remove the building to West Philadelphia was read.—Mr. Meehan referred to his former communication on the formation of species of dog-wood as affected by the principles of acceleration and retardation.—Professor Wilson spoke of the relation of various vegetable substances to electric filaments as bearing upon electric illuminations.—Mr. Redfield detailed the nature of botanical travel one hundred years ago. —Professor Dolly offered some remarks on Bahama plants.—Professor Rothrock described the sand dunes of Lewes, Del. May 14, 1889. Mr. Pilsbry spoke of the modifications of the odontophores in the Rhipidoglossa.—Mr. Ford referred to a new species of Helix from New Guinea, and to a group of fossil olives from Florida.—Mr. Wilcox described the habits of *Fasciolaria gigantea* from Florida. Mr. Campbell exhibited specimens of the genus Cypræa illustrating the convergence of species.—Professor Ryder gave the results of his studies into the structure of the transparent tissues surrounding the eye of the common shad. May 21, 1889. Professor Ryder gave the substance of a paper on Volvox.—Dr. Rex spoke of the development of a species of myxomycetes, *Clathroptychium rugulosum*.—Dr. Wingate exhibited specimens of the genus Physarum. May 28, 1889. The following resolution adopted: *Resolved*, That the Academy, in accordance with the recommendation of the Council, declines to accept the proposition made by the Provost of the University to move the institution to West Philadelphia.—Professor Ryder recounted recent investigations of heterocercous fishes.—Mr. Wilcox stated that

eggs of Ampularia sent to Wagner Institute had all hatched out.

June 4, 1889. Professor Heilprin placed on record the finding of the first fossils in the limestone near Henderson Station.—Mr. Woolman exhibited a specimen of cretaceous limestone outcrop from the neighborhood of Clementown, N. J., full of *Trochosmilia atlantica.*—Professor Sharp described the extinct circular crater of St. Vincent.—Mr. Rand exhibited specimens of serpentine pseudomorph after asbestos, found near Radnor Station, and a variety of Iceland spar from Rossy Wene, N. J.—Mr. Jefferis exhibited a specimen of clinoclase from the Birmingham quarries. June 11, 1889. Dr. Horn exhibited a collection of beetles injurious to vegetation.—Dr. Skinner exhibited two rare papilios (*P. dasorada*) from Sikkim, India, and and an X butterfly from the Andaman Islands.—Dr. McCook made a communication in the sense of hearing of spiders. June 18, 1889. Professor Ryder described the larva of a species of salamander Amblystoma, which showed heterocercy. He also described the occurrence of hypertrophied hairs on the tips of the shoots of Ampelopsis.—Professor Sharp told of some carnivorous bats.—Dr. Rex exhibited a rare fructification of one of the black molds.—Dr. Hall called attention to aspergillus growth from a Brazil nut.—Mr. Wingate exhibited a box containing some enteridium.

Boston Society Natural History.—President, F. W. Putnam; Vice-Presidents, John Cummings, G. L. Goodale; Curator, Alpheus Hyatt; Honorary Secretary, J. C. White; Secretary, J. Walter Fewkes; Treasurer, Charles W. Scudder; Librarian, J. Walter Fewkes; and twenty-five Counciilors.

The following papers were read: Mr. A. F. Foerste spoke of "The Palæontological Horizon of the Limestone Beds of Nahant."—Mr. J. E. Wolff read a paper on "Some Metamorphic Rocks in the Green Mountains.—Mr. A. F. Foerste then considered "The Fossils of the Clinton Group of Indiana and Tennesee."

Biological Society of Washington—The following communications were read: January 26, 1889. Dr. Cooper Curtice, Notes on the Sheep Tick, *Melophagus ovinus* Linn.—Dr. Geo. Vasey, New Species North American Gramineæ of the Last Twelve Years.—Mr. Th. Holm, Contributions to the Morphology of the Genus *Carex.*—Dr. C. Hart Merriam, A new species of Pika (*Lagomys*).

February 9. The following papers were read: Mr. B. F. Galloway, Diseases of the Sycamore.—Dr. Thomas Taylor, A new Freezing Microtome.—Mr. A. A. Crozier, Influence of Foreign Pollen on Fruit.—Mr. J. N. Rose, Geographical Distribution of the Umbelliferæ.—Dr. C. Hart Merriam, A New and Remarkable Vole from British Columbia.

February 23d. Mr. E. M. Hasbrouck, A New Maryland Yellow-throat.—Mr. M. B. Waite, Notes on *Melampsora hydrangeæ* Lusk. Notes the Seed Vessels of the Lop Seed *Phyrma leptostachya.*—Mr. Chas. D. Walcott, The Genus Olenoides of Meek.—Dr. R. L. Stejneger, Notes on Pallas' Cormorant.—Mr. F. V. Colville, The Fruit of *Stipa spartea.*—Dr. C. Hart Merriam, A New Marmot from the Sierra Nevada.

March 9.—Mr. Geo. B. Sudworth, Variations in the genus *Quercus.*—Mr. W. B. Barrows, Dangerous seed-planting by the Crow.—Dr. C. Hart Merriam, A new Ground Squirrel from the Southwest.—Mr. Chas. D. Walcott, The Genus *Olenellus* of Hall.

March 23. Dr. W. H. Seaman, Our Present Knowledge of the Rotifers.—Mr. C. L. Hopkins, A Point of Definition.—Mr. Geo. B. Sudworth, Variations in the genus *Quercus.*—Mr. W. H. Dall, Reproductive Organs in Certain forms of Gasteropoda.

April 20. Prof. Joseph F. James, The Effect of Rain on Earthworms.—Mr. F. W. True, The Occurrence of Sowerby's Whale on the Coast of New Jersey.—Mr. Theo. Holm, The Germination of Sarracenia, Rheum, Peltandra, Hemerocallis and Cyperus.—Dr. C. Hart Merriam, A new Vole from the Gulf of St. Lawrence.—Mr. Geo. B. Sudworth, The Influence of Odor in Attracting Insects.

May 4. Mr. W. T. Hornaday, Exhibition of a Specimen of the Black-footed Ferret (*Putorius nigripes*).—Mr. B. E. Fernow, Annual Ring-Growth.—Dr. Theobald Smith, Parasitic Prozotoa (*Coccidia*) in the Renal Epithelium of a Mouse.—Dr. H. E. Van Deman, Tropical Fruit of the Lake Worth Region.—Dr. C. Hart Merriam, A new Spermophile from Arizona.

May 17. Dr. C. Hart Merriam, Two new Spermophiles from the Lower Colorado, with remarks on the Importance of the Type Locality in the Study of Species.—Dr. Cooper Curtice, How Entozoa Cause Disease.—Mr. Frederick W. True, Exhibition of a Skull of a Female Narwhal with two well developed Tusks.—Mr. L. O. Howard, Notes on Spider Bites.—

Mr. C. D. Walcott, Description of New Genera and Species of Lower Cambrian Fossils.

WICHITA ACADEMY OF SCIENCE.—On Saturday, April 6th, 1889, the Wichita Academy of Science was organized, having for its object "to promote the study of science and stimulate original investigation." The officers elected for the ensuing year are as follows:

President, J. M. Naylor, A.M.; 1st Vice-President, M. E. Crowell, A.B.; 2d Vice-President, W. A. Crusinberry, A.M.; Recording Secretary, J. S. Foote, M.D.; Corresponding Secretary, Fred L. Johnson, M.D.; Treasurer, F. J. Ford; Curator, E. L. Kemp, A.M.; Librarian, F. L. Hinsdale, M.D.

Regular meetings are to be held on the first Saturday of each month.

THE KENT SCIENTIFIC INSTITUTE, GRAND RAPIDS, MICH. —The following is the list of the officers for 1889:

President, E. S. Holmes; Vice-President, W. A. Greeson; Recording Secretary, C. W. Carman; Corresponding Secretary, E. S. Holmes; Treasurer, C. A. Whittemore; Director of the Museum, W. A. Greeson; Curator, C. W. Carman; Librarian, E. L. Moseley. Board of Directors: Wright L. Coffinberry, W. A. Greeson, Samuel L. Fuller, E. S. Holmes, J. W. Jones, C. A. Whittemore. Officers of the Board: Chairman, W. A. Greeson; Secretary, E. S. Holmes; Treasurer, C. A. Whittemore.

CHICAGO ACADEMY OF SCIENCES.—A regular meeting of the Academy was held in the Art Institute, Michigan Boulevard and Van Buren Street, March 12th, at 8 o'clock. The evening was devoted to a conversation on the "Great Glacial Moraine at Lombard, Illinois," as examined by the Academy, at the excursion in June, 1888.

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND.— Nov. 10th, 1888. This being the annual meeting, officers for the ensuing year were elected as follows: President, L. P. Gratacap; Treasurer, Samuel Henshaw; Recording Secretary, K. B. Newell; Corresponding Secretary, Arthur Hollick; Curator, W. T. Davis.

December 8th. Mr. L. P. Gratacap read the following paper upon the "Relation Between the Growth and Form of Leaves:"

It is obvious that the form of leaves must be the resultant of rates of growth in various directions. That a simple leaf with a single midrib will assume such a mature form as will express the equilibrium of the growing impulse along two axes, a longitudinal and a lateral one, and that as this ratio varies in favor of the first or the second, the leaf becomes ovate, circular, broadly elliptical, etc., or lanceolate, linear and elongated. And secondarily, in the case of the simple leaf, the point of intersection of the axis will modify the final form. If the lateral axis is developed at an early stage in the elongation of the midrib we have ovate leaves, if at a point half way along its length elliptical, if at the distal extremity obovate. And in leaves of a complex structure, whether palmate, pinnate or numerously veined with woody and rigid vascular fibres, we can resolve the entire form into a group of simple forms, wherein we may study the related rates of development in lamination (formation of parenchyma), and in vasculation (formation of ribs, veins, etc.). In other words, the rapid movement forward of rib cells would appear to interfere with or prevent the making of the leaf lamina, and their slow movement to assist it. In a leaf with several ribs, the slow progress of the rib-making permits the coalescence of the marginal tissues, and forms polygonal and crenate circular leaves, and also tends to introduce bifurcation and deliquesence of the original fibre bundles. In one, where the extension of the ribs is rapid, this coalescence is checked, and the leaf is sinuate, lobed, irregular and pinnatified.

It is thus apparent that a determination of the *actual* rate of growth in leaves may throw some light or be useful in assisting speculation as to the origin of leaf forms. And it is also apparent that there might be a condition of things exactly the reverse of our supposition given above, and yet produce the same result. That is, a linear leaf might be a, so to say, slowly made leaf as well as a quickly made leaf, if the movements of its parts maintain a ratio which gives extension in length and not in breadth. And in many cases of turgid and dense tissues in leaves this is probably so.

However the measurement of a number of leaf growths including those of Morning-glory, Musk-melon, Water-melon, Maples, *Magnolia*, Beach, Japanese Quince, Five Finger, etc., made this year on Staten Island, do seem to show that the elongated leaves grow much the more rapidly, that the palmate and pinnate leaves stand next in order, and the circular and

transverse leaves last. [A diagram was here presented showing these results in part, with the rate per day of growth, also the slowly diminishing rate of growth of the leaf as it approached completion.]

Of course a number of considerations occur at once to modify the wholesale use of this conclusion. The relative size of the leaves compared should be similar, the condition of healthfulness of the plants alike, the nature of the plant tissue nearly the same, and the position and aspect of the leaves, as regards favorable or unfavorable conditions for growth, identical. The subject is suggestive, and carefully followed up might lead to interesting results.

Mr. Arthur Hollick showed fossil leaf impressions in ferruginous sandstone, found near Arrochar Station by Mr. Gilman S. Stanton. They are undoubtedly from the same formation as those from Tottenville (Cretaceous ?) described in the Proceedings of December 8, 1883, and like them, were not in place where found, but occurred in Drift rocks. The specimens are too fragmentary for determination, but the fact of their discovery at this new locality is a matter of interest and is therefore placed upon record.

Specimens of bowlder clay from the same locality were also shown. It has been lately utilized for brick making. There is a fine exposure of modified drift, overlaid by bowlder drift, where the railroad has been cut through.

Dr. A. L. Carroll noted the discovery on Staten Island recently of *Bothryocephalus latus*—the first reported occurrence of this parasitic worm in America.

Specimens of the "Large Mocker Nut," *Hicoria alba*, (L.) Britton, *var. maxima* (Nutt., Britton.), were presented—being an addition to the local flora. They were collected by Dr. Britton near Court House Station.

February 9, 1889. Mr. Chas. W. Leng read a paper upon "The Buprestidæ of Staten Island," illustrated by specimens of the species mentioned.

It is thought that the larvæ of many species take years to perfect their growth, and an instance is recorded of a *Buprestis* emerging from the wood of a desk that had been in use for twenty years. One of our commonest species. *Chrysobothris femorata* is, however, said by Packard to complete its transformations in twelve months, so the usual period is uncertain.

This insect is found every year in numbers on oaks and

occasionally other trees. I took the greatest number about 1880, when Mr. Davis and I found a log near Silver Lake literally alive with them. They would take short flights and lighting on the log, hide in the crevices of its bark, which, by their color and deep-wrinkled furrows, they simulate to a degree. Many other species have this restless habit of flying from place to place, and on the wing look and buzz very like flies.

Two species of *Agrilus* are also abundant—*ruficollis* and *otiosus*—the first usually on wild blackberries and the second on a variety of young saplings. When the trees around Marling's Pond were cut down about three years ago, a growth of saplings sprang up on which the species of *Agrillus* were quite plentiful and besides many *otiosus* an occasional *bilineatus* or *interruptus* was found.

I have never found any of our other species in great numbers. Of the *Anthaxia* all my specimens have come from a clump of wild cherry in the Clove Valley. *Chalcophora* is said to breed in pine, but a good deal of beating has yielded little. The species have been found washed upon the beach and one specimen of *liberta* was taken by Mr. Davis flying at Watchogue. Two species of *Brachys* occur on the leaves of certain oaks, and I have found them in North Carolina in great numbers. Probably they will be found abundantly somewhere on Staten Island.

Chrysobothris azurea was a notable capture of 1886, and is everywhere counted a rare insect, but from May to July of that year it was plentiful on a species of dogwood in a thicket now burned over and turned into "Prohibition Park." The house, built, as I am told, for the dominie, stands just above where the first was taken. The beetles were very quick in their movements, and were captured by beating the trees over an umbrella, out of which they flew again as soon as they touched it. Several were observed resting on the main stems of the young trees with the anterior legs extended and the last ventral segment touching the bark and they were probably females depositing their eggs. None have been found since 1886, nor have I been able to find the larvæ in the few trees that are left.

Attention was called to the recent death of Mr. S. Elliot Lowell.

March 14, 1889.—Mr. L. P. Gratacap showed specimens of

fossils from a drift bowlder and gave the following account of the same:

Mr. C. S. Egbert in excavating a foundation for a house at Fort Wadsworth station on the Rapid Transit Railroad, on the north side of the Fingerboard Road, and a few hundred feet northeast of the station, uncovered a bowlder of Oriskany Sandstone which upon examination by Mr. Wm. T. Davis proved to be of great interest. It was a compact mass of fossils representing over twenty species characteristic of that horizon, of which fourteen were new to our list previously published (Extra No. 6, March, 1887.) Amongst these were some of considerable rarity, and while many were in a fragmentary condition or preserved as impressions only, they were all unmistakably identified, and form a valuable addition to our palæontological possessions.

The list of new additions is as follows:

Pholidops arenaria, Hall.
Streptorhynchus hipparionyx, Vanuxem.
Strophodonta magnifica, Hall.
Chonetes campalnatus, Hall.
Leptæna nucleata, Hall.
Spirifera pyxidata, Hall.
Leptocœlia flabellites, Conrad.
Eatonia peculiaris, Conrad.
Rennsselaeria ovoides, Eaton.
Pterinea Gebhardi, Hall.
" *textile*, Hall,
Aviculopecten rectirostris, Hall.
Platyceras nodosum, Conrad.
Platyostoma ventricosum, Hall,

Mr. Arthur Hollick exhibited mounted specimens of new or noteworthy additions to the local flora and read the following memoranda in connection with them:

Since the fourth appendix to the Flora of Richmond County was published, about two years since, there have been many plants found which require recording. The full list, containing thirty-six species and varieties new in our Island's flora, will be published as usual in the *Bulletin of the Torrey Botanical Club*, as the fifth appendix. Reprints of the same will be distributed to all those desiring them. Memoranda in regard to some of the species have been published in our Proceedings,

while others have not been recorded, although of considerably interest.

For several years specimens of a peculiar *Ranunculus* were collected in the Clove Lake Swamp. They were classed under the species *fascicularis*, the common Early Buttercup, although plainly not identical with it. The most remarkable characteristic of all the plants was a tendency to fasciation which showed itself year after year, and may be seen in all the specimens collected. The species has lately been determined to be *Ranunculus septentrionalis*, Poir. Thus far it has not been found in any other locality on the Island.

In studying the herbarium of the late Wm. H. Leggett many plants were noted as having been collected on Staten Island. Amongst the most interesting were several specimens of *Lechea racemulosa*, Lam, from Tottenville, mixed with and included under the name of *L. thymifolia*, Michx.

Trifolium hybridum, L., supposed to be a hybrid between the Red and White Clovers, is becoming more common, and may be now found along many of the streets of New Brighton, and also on the filled-in ground at St. George.

A species of Honeysuckle was admitted into the last appendix under the name of *Lonicera ciliata*, Muhl. A single bush in flower was found in some cedar woods just north of Garretsons. It was undoubtedly native where found. Since then, Mr. Wm. T. Davis has discovered the plant, in fruit, in a similar situation at New Brighton. With the material now in our possession we are enabled to determine it to be *L. xylosteum*, L , the European Fly Honeysuckle, which has somehow become established and thoroughly naturalized here, probably through the agency of birds.

On May 30, 1888, a single plant of *Cynoglossum officinale*, L., was found in a field near Richmond. The only other time that this plant was reported from the Island was in 1880, when a single specimen was found near Concord.

Amarantus hybridus, L., in every stage of hybridization between the green Pigweed and the red Prince's Feather is common along the streets and in waste places in New Brighton.

Thus far I have failed to find a Butternut tree growing here independent of cultivation, but in the Trans. N. Y. State Agri. Soc., for 1843, there is a list of the trees common on Staten Island, by Dr. Samuel Ackerly, and this tree is included in the list, under the name of *Juglans cathártica*, Michx. It

is quite possible that at that time it may have been native here.

Mr. Wm. T. Davis has reported the discovery of several more trees *Betula nigra*, L., the Red or River Birch, near Richmond, Annadale and Old Place, but the total number of trees is so small that the speedy extermination of the species on the Island is certain.

Salix purpurea. L., the Basket Willow, has become established in several localities notably near Garretsons and Old Place. These trees no doubt originated from cuttings of cultivated trees which were thrown aside in rubbish heaps. At Garretsons their presence is easily accounted for by the old plantation belonging to the late John Reed, which has been cultivated for generations. No doubt at Old Place there was also a plantation, although no indication of it was noticed. A single isolated tree was found on a roadside near Woodrow.

A single tree of the Hemlock Spruce (*Tsuga Canadensis*, L.) was found near Old Place. It is a somewhat conspicuous object as it is the only large tree, and an evergreen at that, left standing in a recently cleared place of woodland, where all the surrounding hardwood trees have been cut down.

In the sandy soil at Mariners' Harbor, Watchogue and Kreischerville occurs abundantly a form of Cat Brier, which is clearly a variety of the common *Smilax glauca*, Walt. The leaves are narrow and elongated, often constricted in the middle so as to be almost fiddle-shaped, and the stem, especially at the base, is thickly beset with prickles. It agrees with the description of the so-called *S. spinulosa*. Smith.

Several of the plants admitted into our catalogue without having been personally seen have been discovered within the past two years. Amongst them may be mentioned *Lathyrus maritimus*, (L.) Bigel., the Beach Pea. This was admitted on the authority of a specimen in the herbarium of the late Dr. Samuel Elliot and it now turns up at New Dorp near the old race course.

Pycnanthemum incanum, (L), Mich., admitted on the same authority, grows on Ocean Terrace.

Salix tristis, Ait., the Dwarf Gray Willow, was credited to Staten Island about twenty years ago in the *Bulletin of the Torrey Botanical Club*. There is a small patch growing south of the railroad between Richmond Valley and Tottenville, within a few yards of the hybrid oaks described in our Proceedings for September and October, 1888, which is probably the same locality where it was originally found.

Sabbatia dodecandra, (L.) (*S. chloroides*, Pursh.,) was reported by Mr. E. M. Eadie from near Chelsea. It was found in the Autumn of 1887 growing abundantly on the salt meadow near Kreischerville.

Dr. N. L. Britton showed specimens of yellow gravel and kaolin and remarked upon a recent discovery of another exposure of the Cretaceous strata which are known to underlie a considerable portion of Southfield and Westfield. This new exposure is on the Fingerboard Road about a quarter of a mile east of Grassmere Station. A cutting in the north side of the road shows a section of glacial and modified drift, under which may be seen some of kaolin similar to that which is so extensively dug near Kreischerville. This is associated with a small amount of yellow gravel. He stated that it could not be positively determined whether the kaolin was exactly in place or had been ploughed up from below and enclosed in the moraine as at the Prince's Bay bluff, already described in the Proceedings, November 8th, 1884.

SCIENTIFIC NEWS.

NATURAL HISTORY AT THE PARIS EXPOSITION.—Although the Paris Exposition has no special biological department, it cannot be said that biology is entirely unrepresented. The Woods' and Forests' Building, in the Gardens of the Trocadero, is composed of trunks and branches of trees native to or naturalized in France, all labelled with their botanical and French names, and the gallery around its interior has a collection of the seeds, leaves, resins, etc., of those trees, as well as of the fungi and insects injurious to them. Around this building are planted examples of native and introduced trees. The exhibit of the Transvaal Republic, in the Invalides Gardens, has a series of the eggs of many South African birds; the Argentine Republic, besides an extensive collection of woods, including many Legumenosæ and Rubicæ, *Zuglans Australes*, species of Myrsine, and large sections of *Cedrela brasiliensis*, has a set of fishes, reptiles, etc., preserved in alcohol, and Gautemala puts forward a fine collection of insects, and quite a number of birds. Most of the exhibits of the smaller and less important countries devote, in fact, a considerable space to their minerals, plants and animals, and this is true not only with regard to America, Australia and Africa,

but also, so far as regards minerals, of some European lands. The United States, important and extensive though it is, and varied though are its products, has nothing biological, and would have nothing mineral were it not for the enterprise of Dr. A. E. Foote, of Philadelphia, and of the exhibitor of the petrified trees of Arizona. Ethnography has not been neglected in the western or Industrial Arts wing, where Greeks are shown painting, pottery, Egyptians engaged in weaving and in agricultural work; and various semi-civilized or barbarous tribes occupied in their primitive methods of manufacture. Part of a hall in this wing of the main building is devoted to illustrations of the anthropology of criminality; and not far away from this a series of wax models, in a private exhibit, showing the effects of cutaneous and syphilitic diseases upon the person, is more pathological than pleasing or moral, but proves very attractive. As a parallel to the last-mentioned exhibit, the veterinary collection in one of the structures near the river may be noticed. Here also the monsters and malformations excite much more interest than anything normal. In the western gallery of the wing devoted to the Industrial or Liberal Arts is a miscellaneous geographical collection, which includes a rather extensive series of the results of the dredgings executed by the Travailleur and the Talisman in their various expeditions, together with the dredges used, and maps showing the course taken and the ocean depths. This collection contains many peculiar forms of fishes, including the renowned *Eurypharynx pelecanoides*, numerous crustaceans cirripeds, and pycnogonids, many echini, asteroids, crinoids and holothurians, and some gastropods lamellibra and brachiopods—all preserved in alcohol; also a dried collection of sponges and corals. Taken as a whole, the so-called "Liberal Arts" Department is the most unsatisfactory, most miscellaneous, and worst-arranged part of the entire Exposition. Perhaps, as time wears on, a catalogue may enable an enquiring visitor to see some order; but as it is, the various scholastic exhibits are an unexplained medley, and one is tempted to ask "Of what use are the few groups of historic, prehistoric and barbarous human beings, the meagre show of processes and results comprised under the head of 'Histoire de Travail,' and the very slim attempt at illustrating comparative anatomy, when within the bounds of the Exhibition itself—in the Trocadero Building—there is a first-rate ethnographical collection, and a splendid series of works illustrating French art

in all its phases? Would it not have been far better to have rounded out these collections with judicious additions, than to have made a separate, iusufficient exhibit?"

In a corner of the centre gallery of the Liberal Arts wing may be found a cast of *Phenacodus primævus* Cope, exhibited by its discoverer. If *P. primævus* could think, it would, like the Doge of Genoa at Versailles, be more surprised "to see itself there" than at anything else.

The aquarium in the Trocadero Gardens is well-stocked with a lively crowd of Cyprinidæ and Salmonidæ, including California salmon, but it has no marine animals.—*W. N. L.*

A course of six lectures on human embryology has lately been completed at Cornell University by Prof. Charles Sedgwick Minot, of Harvard Medical School; intended to supplement the practical course in chick development, given a year ago by Associate Professor Gage (who is in Europe this Spring). These lectures presented clearly the history of the ovum, karyokenisis, the germ layers, and the formation of certain organs, especially the heart. The closing discourse, on Theories of Heredity, was given on Thursday, the 9th of May, before a large audience of professors, trustees, advanced students and physicians.

RECENT BOOKS AND PAMPHLETS.

Annual Report for the Year 1888–9 of the Trustees of the American Museum of Natural History, Central Park, New York.

Bell, A. G.—On Reading as a Means of Teaching Language to the Deaf. From the Author.

Boettger, Otto Von.—Uber die Reptilien und Batrachier Transcaspiens. Separat Abdruck aus dem Zoologischer Anzeiger. No. 279. 1888.

Boulenger, G. A.—On the Chelydroid Chelonians of New Guinea.

————Description of a New Batrachian of the Genus *Eupemphix* from Trinidad. Extract from the Annals and Magazine of Nat. Hist. for April, 1889.

————Description of Two New Australian Frogs. Extract from the Annals and Magazine of Nat. Hist., August, 1888.

————Note on Classification of the Ranidæ. Extract from Proceedings of London Zoological Society, March 20, 1888. From the Author.

Brongniart, Charles.—Les Insectes Fossiles des Terrains Primaires. Extrait du Bull. de la Société des Amis des Sciences Naturelles de Rouen (année 1885).

————Les Entomophthorées et leur application à la destruction des insectes nuisibles.—Sur un gigantesque neurorthoptère, provenant des terrains houillers de Commentry (Allier).—Les Blattes de l'époque houillère·—Sur un nouveau Poisson fossile du terrain houiller de Commentry (Allier). From the Author.

Bull. U. S. Dep. Agriculture, November, 1888. Devoted to the Economy and Life Habits of Insects. From Norman Coleman, Commission of Agriculture.

Bulletin of U. S. Geological Survey, Nos. 44 and 45. From Department of the Interior. Catalogue de l'Exposition Géologique.

Chapman, Frank M.—Preliminary Description of Two Apparently New Species of the Genus *Hesperomys* from Florida —A New Sub-Species of the Genus *Sigmodon* from Florida.—On the Habits of *Neofiber alleni* True.—Extracts from Bull. Am. Mus. Nat. Hist., Vol. II., No. 3, June 7, 1889. From the Author.

Cross, Whitman.—The Denver Tertiary Formations. Extract from the Am. Journ. of Sciences, Vol. XXXVII., April, 1889. From the Author.

Day, David T.—Mineral Resources of the United States. Bull. of U. S. Geol. Survey. From the Author.

Dollo, Louis et Storms Raymond.—Sur les Téléostéens du Rupélien. Separat Abdruck aus dem "Zoologischer Anzeiger." No. 279. 1888. From the Authors.

Dollo, Louis—Sur le Crâne des Mosasauriens. Extrait de Bull. Scientifique de la France et de la Belgique.

————Encore un Mot sur *l'Aachenosaurus multidens.* Extrait du Bull. de la Société Belge de Geologie. Tome III., 1889. From the Author.

Dugés, Alfredo.—Sur du espéces nouvelles des Ophidiens de Mexique. Read before the Am. Philosophical Soc., May 4, 1888. From the Author.

Edwards, Chas. L.—The Influence of Warmth upon the Irritability of Frogs' Muscle and Nerve. From the Author.

Forbes, S. A.—On the Food Relations of Fresh Water Fishes. Bull. Ill. State Lab. Nat. Hist., Vol. II. From the Author.

Frazer, Persifor.—Reply to Articles Concerning the American Committee of the International Congress of Geologists, by Prof. J. D. Dana and Maj. Powell, in Am. Journ. of Science for Dec., 1888. From the Author.

Garman, Sam.—An Andenn Medal.—The Batrachia of Kalm's "En Resa til Norra America." From the Bull. of the Essex Institute. Vol. XX., 1888.

———On the Lateral Canal System of the Selachia and Holocephala. Bull. of the Museum of Comparative Zoology, Vol. XVII., No. 2, Harvard College.

———A Large Carp and its History. Reprint from the Proceedings of the Boston Soc. Nat. Hist. From the Author.

Genth, F. A.—A Letter to the Hon. the Board of Trustees of the University of Pennsylvania. From the Author.

Hector, James.—Report on Phormium Tenax as a Fibrous Plant. Bull. Colonial Museum and Geological Survey Department.

Hitchcock, E.—The Anthropometric Manual of Amherst College. 1887. From the Author.

Ireland, William.—California State Mining Bureau. Seventh Annual Report.

Jordan, David, and *Carl H. Eigenmann.*—A Review of the Sciænidæ of America and Europe. From the Authors.

Kimball, James P.—On Production of the Precious Metals in the United States. From the Author.

McGee, W. J.—Dynamical Geology. Extract from the Geological Magazine, Nov., 1888. From the Author.

Report of the American Committee of the International Congress of Geologists. July 2, 1888.

Rhumbler, Ludwig.—Die Verschiedenen Cystenbildungen und die Entwicklungsgeschichte der Holotrichen Infusoriengattung Colpoda. From the Author.

Riley, C. V.—The *Icerya* or Fluted Scale. Bull. No. 15, U. S. Department of Agriculture. From the Author.

Ryder, J. A.—Evolution of the Specialized Axes of the Higher Types. Reprint from the University Mag., April, 1889. From the Author.

Scott, J. H. and *T. Jeffery Parker.*—On a Specimen of Ziphius recently obtained near Dunedin. Extract from the Trans. Zool. Soc. of London. Vol. XII., Part VIII., 1889. From the Authors.

Scribner, F. L. and *Pierre Viala.*—Black Rot. Bull. No. 7, Dep. of Agriculture. From the Commissioner.

Shufeldt, R. W.—On a Collection of Birds' Sterna and Skulls, Collected by Dr. Thomas Streets, U. S. N. Extract from Proceedings of U. S. Nat. Museum. From the Author.

Smith, Eugene A. and *Johnson, L. C.*—Tertiary and Cretaceous Strata of the Tuscaloosa, Tombigbee and Alabama Rivers. Bull. of U. S. Geol. Survey, No. 43. From the Dept. of the Interior.

Topinard, M. P.—Les Dernièrs Etages de la Généalogie de l'homme. Extrait de la *Revue* Anthropologie. From the Author.

Trouessart, E. L.—Diagnoses d'Especès Nouvelles de *Sarcoptides plumicoles* (*Analgesinæ*). Extrait de Bull. Scientifique de la France et de la Belgique. From the Author.

Ward, Thomas Humphrey.—International Copyright in Works of Art. From the Author.

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Whiteaves, J. F.—Illustrations of the Fossil Fishes of the Devonian Rocks of Canada. Extract from Trans. Roy. Soc., Canada. From the Author.

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Wolterstorff, W. Von.—Ueber fossile Frösche, insbesondere das Genus Palæobatrachus. From the Author.

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